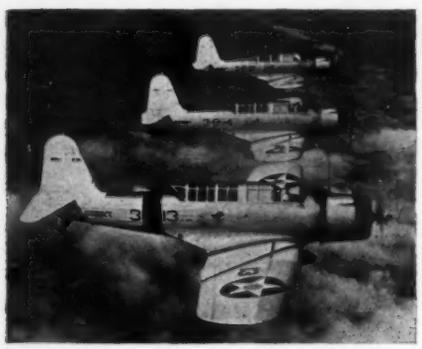
AMERICAN MACHINIST

May 31, 1939



Fighters—*Pratt & Whitney Aircraft makes engines for the Air Force the expansion of which is a vital part of the U. S. program for defense (page 369)*

ANNUAL MODERN PLANT NUMBER

devoted to

Industrial Mobilization

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VOLUME 83 NUMBER 11

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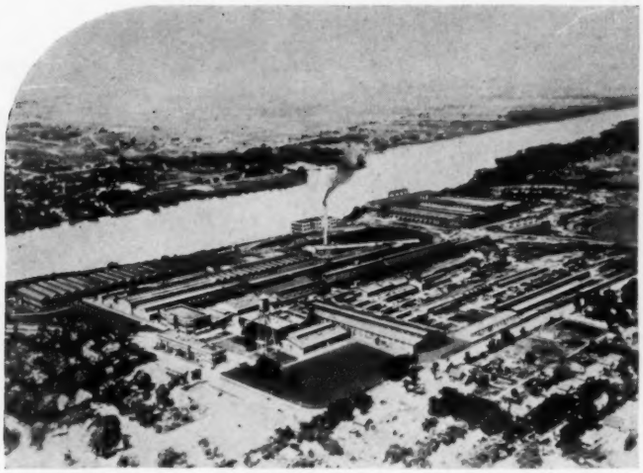
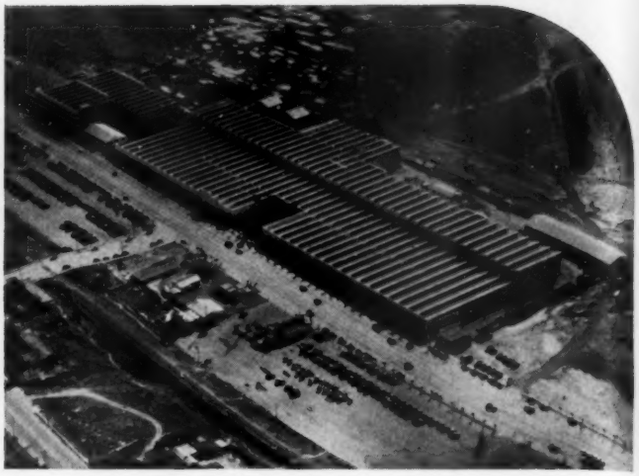




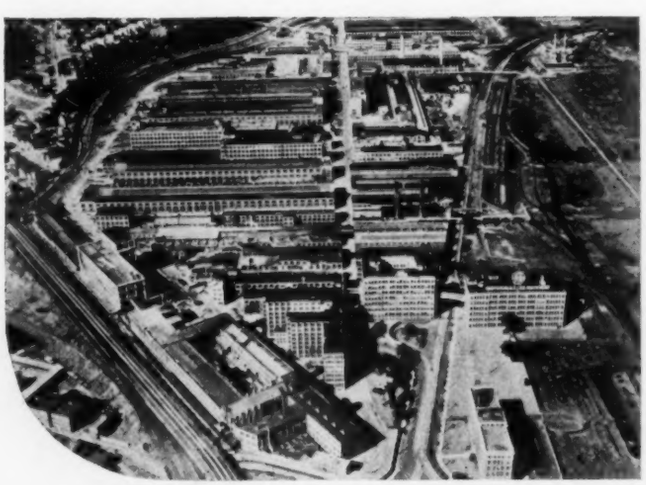
★ BACKBONE OF DEFENSE ★

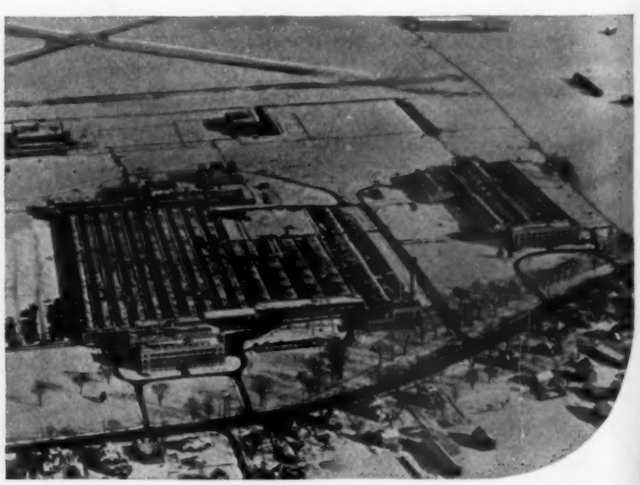
TO our traditional mighty Navy and its shore support, the Army, have been added in the past twenty years their wings of defense—the air forces.

The backbone of the two great branches, as well as of their air auxiliaries—in fact the backbone of defense—is metal-working; for here is the foundation of a prepared nation. Here the arms of the nation must be built in emergencies. And here preparedness develops from fiction into reality.

Since the first of the year we have presented four special sections on National Defense conditions. America's general defense position and needs were outlined in "For National Defense", January 11. Following this report a series of three sections described actual plant conditions in the arsenals (February 8), navy yards (March 22), and air bases (April 19).

To this series we now add INDUSTRIAL MOBILIZATION. This issue will give you a picture of metal-working's part in National Defense—will bring the "Backbone of Defense" to life. Here you will find described actual production methods of handling government orders—many adaptable to your own plant conditions. Here also, in the advertising pages, is equipment at work on the jobs. Read this issue carefully—save it for future reference on your own production problems.

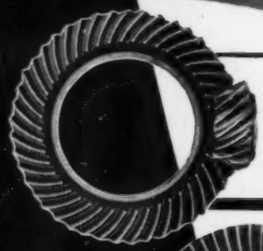




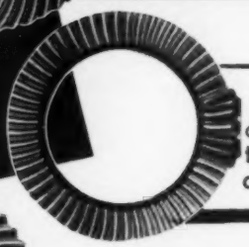
INDUSTRIAL MOBILIZATION ★ A RESPONSIBILITY

Cut all 3

ON THE No. 16 HYPOID GENERATOR



SPIRAL BEVEL GEARS
smoothness, quietness and strength under all operating conditions



***ZEROL BEVEL GEARS**
controlled, localized tooth contact of spiral bevels with thrust characteristics of straight bevels

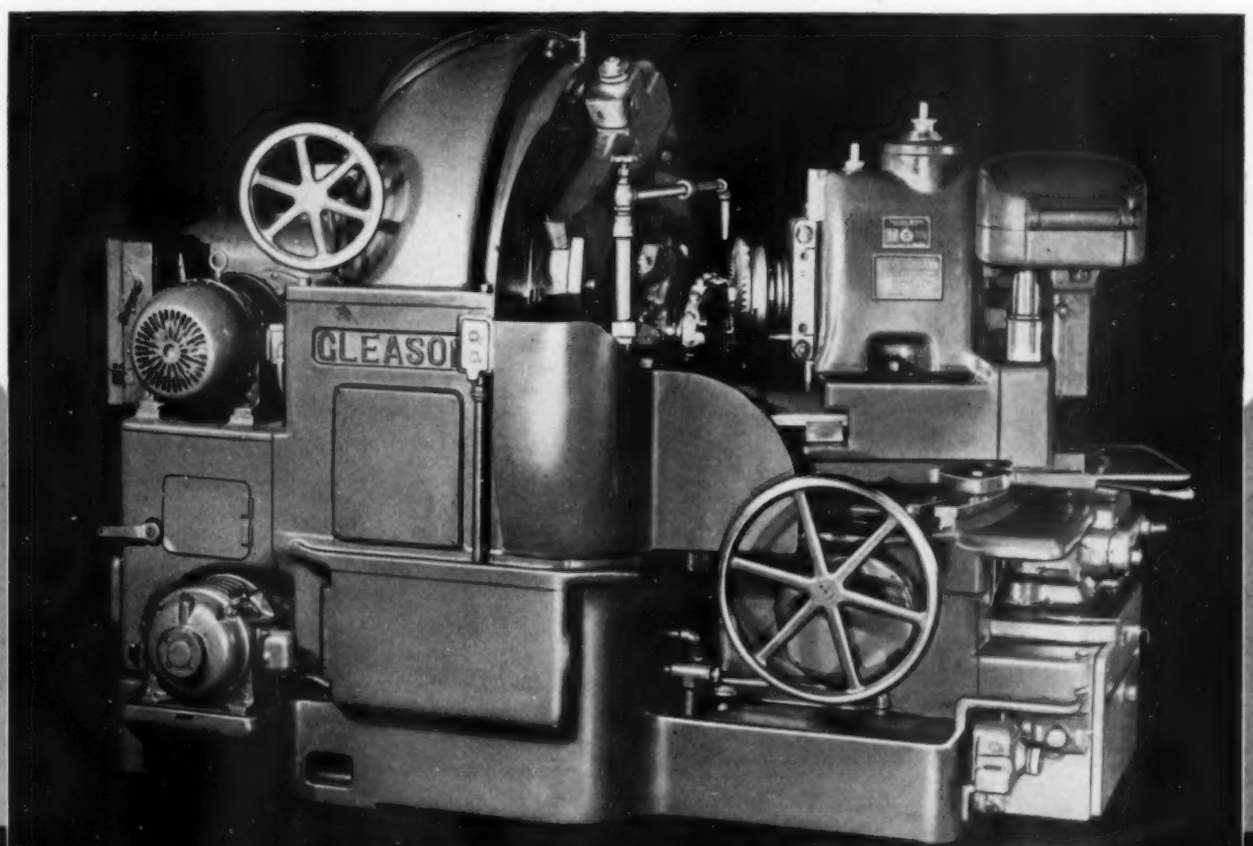
HYPOID GEARS
smoother and stronger than spiral bevels plus pinion-shaft offset

SPIRAL bevel, Zerol bevel and hypoid gears —you can cut all three on the Gleason No. 16.

The No. 16 combines the speed and quality of a production machine with the wide range of pitch and gear diameter required for jobbing. Tooling cost is low on the No. 16—only a few cutters are required for the entire range of spiral bevel and Zerol gears.

A suggestion—replace your straight bevel gears with Zerols or spiral bevels and cut all bevel gears on the No. 16. Write for detailed information.

*Reg. U. S. Pat. Off. Pat. Pending. A curved-tooth bevel gear with zero-degree spiral angle. Zerols are replacing straight bevel gears where thrust limitations prevent the use of spiral bevels. Zerols can be substituted for straight bevels without change in mountings. Like spiral bevels, the localized tooth contact of Zerols allows for slight displacements without concentrating the load dangerously near the ends of the teeth.



No. 16 HYPOID GENERATOR

GLEASON

GLEASON WORKS

Builders of Bevel Gear Machinery for Over Seventy Years

1000 UNIVERSITY AVENUE ROCHESTER, N. Y., U. S. A.

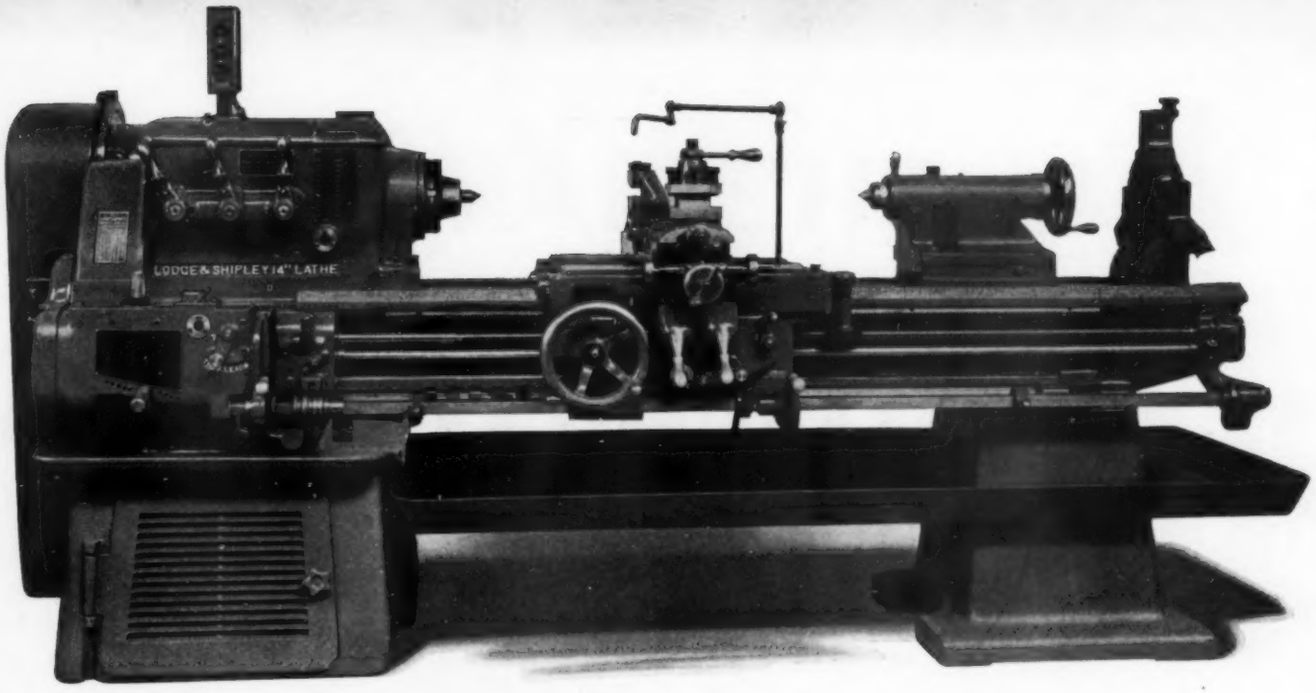
MORE GUNS *for National Defense*

L & S

MANUFACTURING LATHES

SPEED GUN BARREL TURNING

THE LODGE &



FOUR 14" Lodge & Shipley Manufacturing Lathes put the finishing cut on gun barrels in the Springfield Armory Forming shop and play an important part in speeding up production.

L & S Manufacturing Lathes assure tremendous time savings on duplicate work regardless of quantity—an important advantage in any shop whether manufacturing weapons of defense or products for normal consumption and use.

Our engineers will gladly show you how you can benefit through turning out your work on modern, versatile L & S Manufacturing Lathes.

L & S LATHES

E & SHIPLEY MACHINE TOOL COMPANY
CINCINNATI, OHIO, U. S. A.

FIRST EDITION

THE SAVE WITH A

TIP No. 1 THE CINCINNATI MILLING MACHINE

NEW AUTOMATIC MILLING

The New 2-18 and 2-24 Plain Automatic Milling Machines for Fast Production of Small to Medium Work

SAVINGS ALREADY REPORTED FROM MANY INSTALLATIONS IN THE FIELD

SPEEDS—up to 1200 R. P. M. . . . FEEDS—up to 40" Per Minute . . .
Constant Speed 5 H. P. Motor

Brand new CINCINNATI milling machine to fit into the production scheme of almost any plant was announced today. It's the NEW CINCINNATI 2-18 or the 2-24 Plain Automatic Milling Machine.

Is used for rapid production of small to medium size parts such as those which go into business machines, sewing machines, hand tools, washing machines, refrigerators, small air-conditioning units as well as medium size automotive and aircraft parts.

Is used for small to medium size parts which will fit into this range:

	2-18	2-24
Longitudinal (power)	18"	24"
Vertical movement of spindle carrier	6"	6"
Cross Adjustment of Quill .	3½"	3½"
Capacity—Enclosed multiple V-belt drive.	5 H.P.	5 H.P.

66⅔% SAVING ACHIEVED

Customers report 2-18 and 2-24 machines have already proven themselves. One sewing machine manufacturer with work too large for the conventional 18" machines and too small for 24" machines, installed group of 2-18's and now reports 66⅔% saving in milling time.

COST REDUCING FEATURES

Performance tests show these machines have plenty of POWER with constant speed 5 H.P. motor. Completely dog-controlled AUTOMATIC table working cycles with intermittent feeds for the table. Have RIGIDITY with **one-piece** fixed bed. QUICK, EASY SET-UP for arbor supports and cutter gangs can be removed without disturbing one-piece arbor support brace. CLIMB-CUTTING with the use of HYDRAULIC BACKLASH ELIMINATOR. Added cost-saving features are AUTOMATIC SPINDLE STOP . . . CINCINNATI RECTANGULAR OVERARM . . . Single START AND STOP LEVER . . . and many others.

ENGINEERS STATE

That literature on the NEW CINCINNATI 2-18 and 2-24 Plain Automatic Milling Machine is available. Interested customers are urged to write for M-814, the new illustrated bulletin.

Or, engineers further add, ask CINCINNATI'S Sales Engineeering Dept. to show you how these new machines will fit into your set-up and reduce your costs. They emphasize the fact that there is no obligation.

TURKEY T
BIG MUN
TRADE

Alliance Expe
British-Ru

LONDON, Ma
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Grilled by

CINCINNATI NEWS

WEATHER Fair and Warmer -- For Coat-Minded Executives.

COMPANY, Cincinnati, Ohio, U. S. A. NO CHARGE.

MACHINE FROM CINCINNATI

"Just Like Sitting Around My Own Table"

Veteran Detective Gives Orders for His Po...

INFORMALITY ... of the ... Hotel ... friends of ... cinnati ... will gath... this ... yes...

BAN ON ... HOSP...

One of First U. C. Students, ... Minister's Widow, Succumbs

... Suffered While Riding in Auto in January Fatal to ...

... the University of Cincinnati and the widow of ... former Episcopal minister, will be held ... at ... home, Walnut Hills, Monday at 10:30 ... ary.

... died late Fr... ital, where she h... since Tuesda... Mrs. Aaron Hub... venue, Kennedy... she lived, attri... to an a...

Mrs. H... Babbi... top of ... over a roug... injured he... said she ... caused h... Babbitt was ... Karrman ... nnati druggi... died 35 yea... tates in various ... ooklyn, N. Y. ... 1 in Cincin... or of a chu... Surviving ar... Babbitt Jr. a... New York. ... nices Mrs. ... Wilcox and ... al, Cincinnati.

Labor ... Precinc...

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... al Thomas J. Her-... we the legal form ... ecretary of State Earl ... will give his sanction be... titions can be distributed ... retary of State's office Inc... with offices probably wo... the forms next week. ... the properly signed petit... filed with Griffith before ... 18, the effective date of the bi... be postponed automatically ... the voters have an opportun... the fall election to affirm o... the Legislature's action in ... ing the so-called life tenu... three officers.

General Marx, Loucks ...

... Down St...

... ans Say She Has ... al Brain Concussion.

... head ... M. Copyock, ... Ha... a ... ow... lived on a small farm on Hunt Road. The Voris funeral home, 310 Dunn Street, Lockland, is in charge of ar-

... Cincinnati and ... ders, an Associated Press ... spatch stated Saturday.

Hard will ask permission to operate transports between Cincinnati, Atlanta, Pensaloca, Savannah and

First line

Percussion rifle, built by Robbins & Lawrence at Windsor, Vermont, 1849.

SINCE 1845 the Jones & Lamson Machine Company has been furnishing the United States Army with equipment for National defense. Lamson, Goodnow & Yale, predecessors of the Jones & Lamson Machine Company furnished rifles and machine tools for the Civil War. Soon after this period, and up to the present day, this firm has concentrated its full energy on the building of machine tools.

On the opposite page is shown a portion of the J & L equipment in one U. S. Armory. The Fay Automatic Lathes are turning gun barrels. The J & L Comparators are keeping a constant check on all sorts of production tools and gauges.

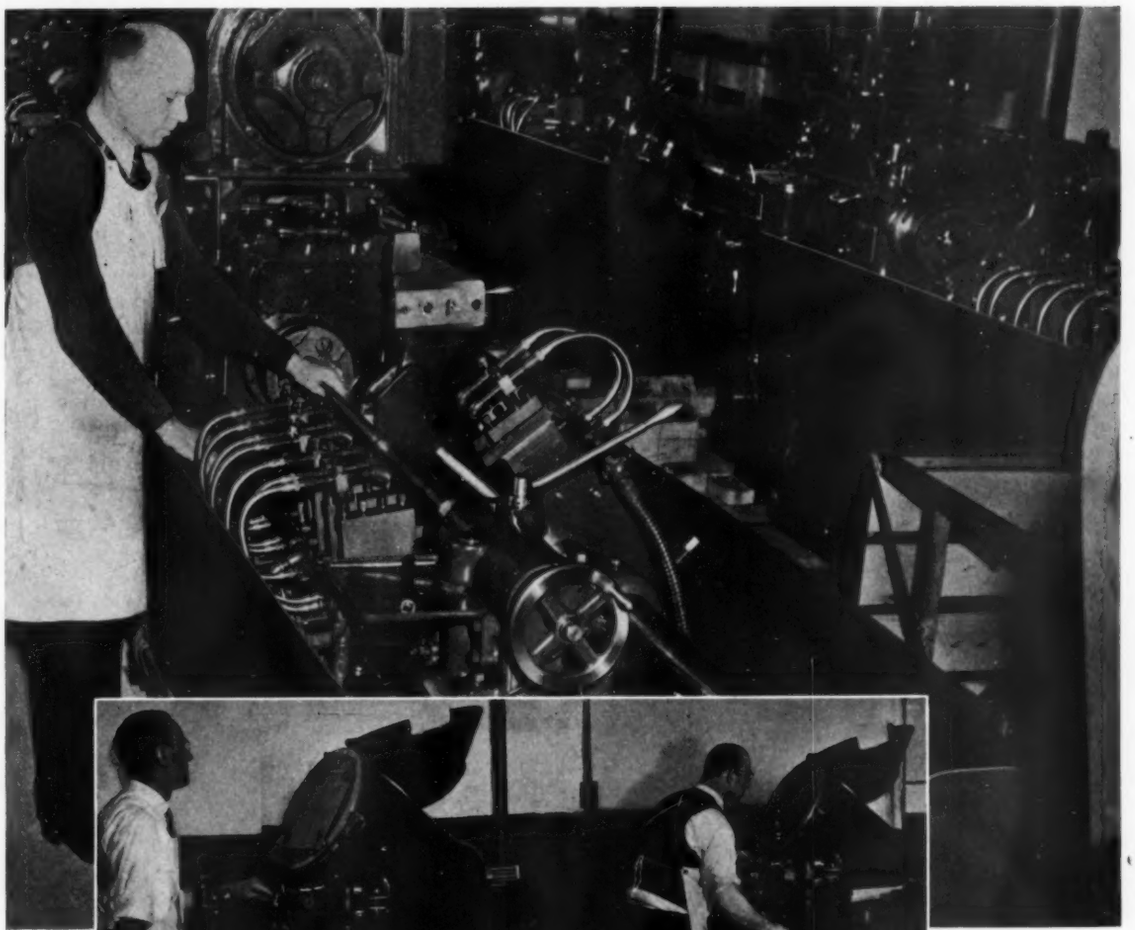
With a background of so many years of experience, J & L is prepared with the latest equipment and information on defense machinery.

Inquiries incur no obligation.

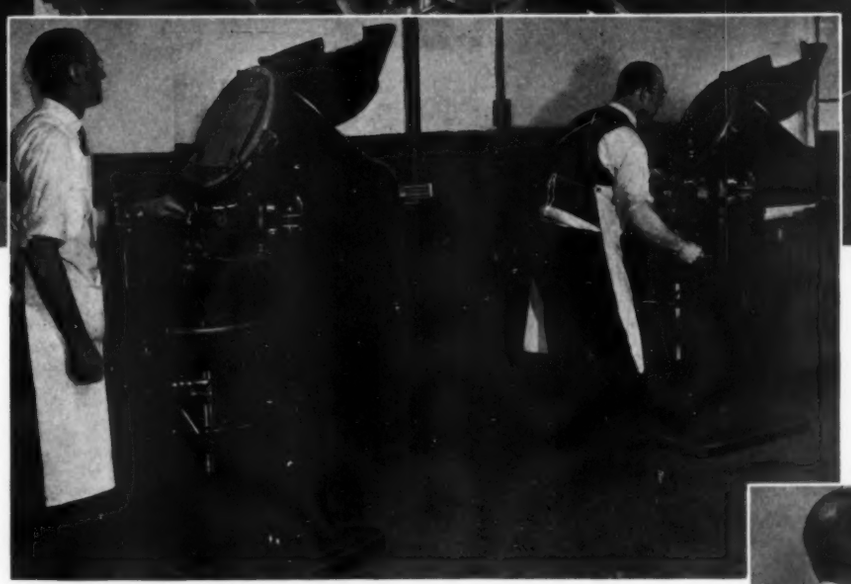
JONES & LAMSON MACHINE COMPANY

Springfield, Vermont, U.S.A.

duty since 1845



One of a battery of 12" Fay Automatic Lathes turning rifle barrels.



Two J & L Pedestal Comparators used in an Armory tool room.

J & L Pedestal Comparator checking a special cutter for semi-automatic rifle part.

No. 1 OF A SERIES OF TALKS ON GEAR FINISHING BY THE FELLOWS METHOD

Still Greater THROUGH

MASSIVE DESIGN

EXTREME RIGIDITY

PRECISION TOOLING

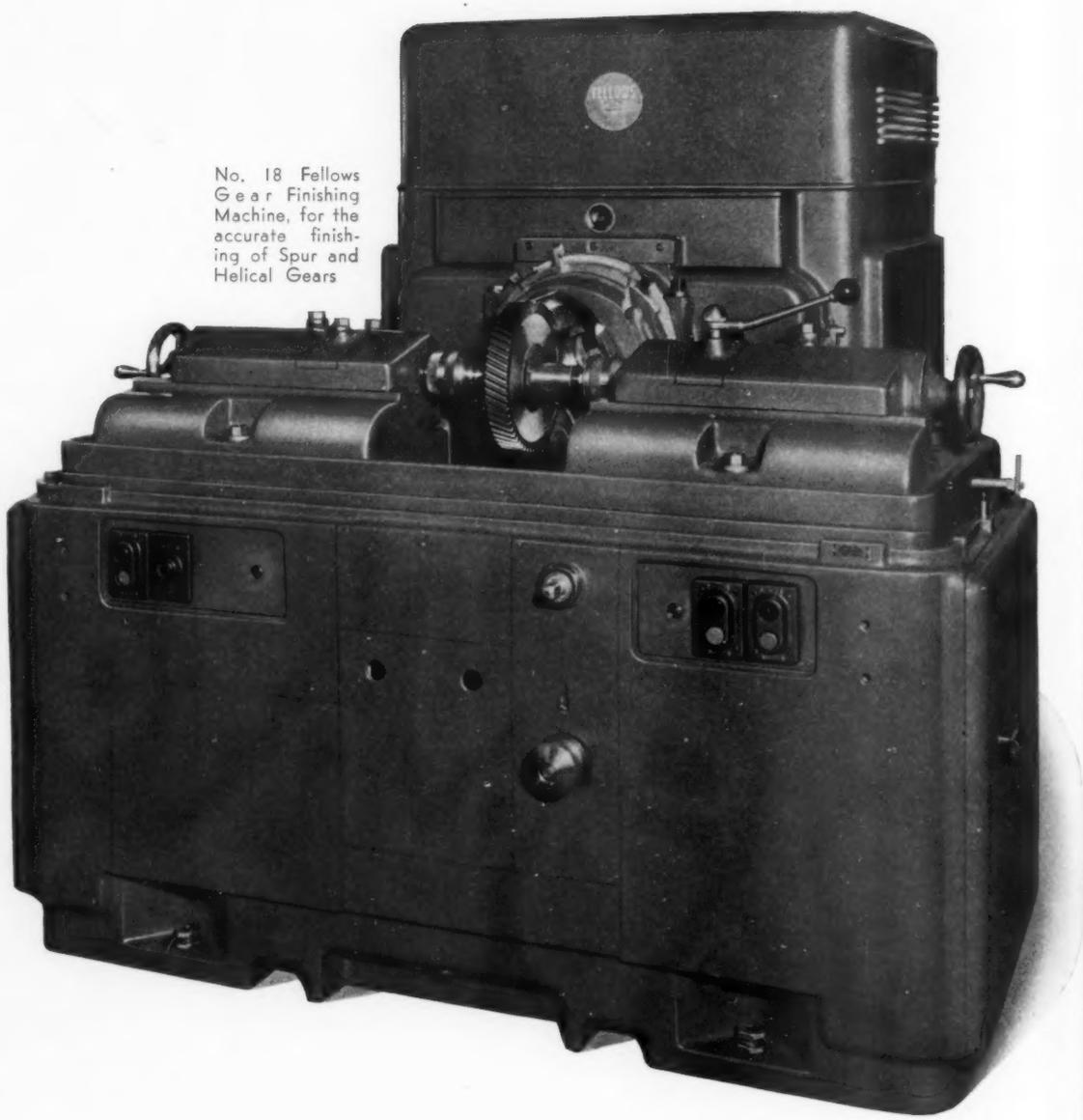
EXCEPTIONAL ACCURACY

ACCESSIBLE LOADING AND UNLOADING

HIGH PRODUCTION

AUTOMATIC CONTROL

LOW LABOR COST



No. 18 Fellows Gear Finishing Machine, for the accurate finishing of Spur and Helical Gears

THE FELLOWS GEAR

78 River Street.

Precision Rigidity!

• Tool spindle and work arbor held to inflexible alignment under maximum tool pressure . . . on the NEW FELLOWS GEAR FINISHING MACHINE

The massive and rigid design and construction of this new Fellows Gear Finishing Machine makes possible still greater control over accuracy—and without limiting production. Particular care has been taken in the design of this machine to transfer the tool thrusts to the massive base and bed with the result that a consistently better finish is obtained, coupled with higher production and longer tool life.

Furthermore, the design of the head and tail stock permits holding many types of gears without the use of special outfits or fixtures. Unusual accessibility facilitates loading and unloading, thus further increasing production.

This machine includes many other exclusive features fully detailed in a new circular which is yours for the asking, write:

FELLOWS
Complete Line for Precision Gear Manufacturing

GEAR SHAPERS
RACK SHAPERS
COMPLETE LINE OF CUTTERS
THREAD GENERATORS
MASTER GEARS
LAPPING MACHINES AND LAPS
HELICAL CUTTER SHARPENERS
BURNISHING MACHINES
TESTING EQUIPMENT

SHAPER COMPANY

Springfield, Vermont—or 814 Fisher Bldg., Detroit, Mich.

+.0000" −.0005" AND 300 AN

A CAMERA manufacturer uses two CINCINNATI No. 2 Centerless Grinders to rough and finish long and short bearings on governor pinions for movie cameras. One Centerless grinds the long bearing, the other grinds the short. Using the infeed method, production is 450 per hour while roughing and 300 per hour while finishing. Roughing limits are $\pm.001" \atop -.001"$ and finishing limits are $\pm.0000" \atop -.0005"$

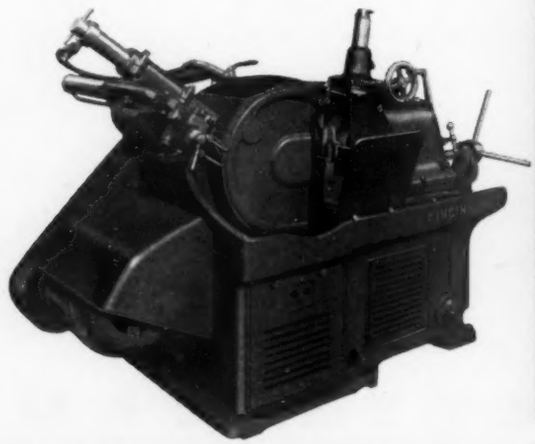
Here's an example of how Centerless Grinders are turning out better jobs at a decided saving in production costs. They will do the same for you.

The Centerless Grinder (an exclusive CINCINNATI product) gives you more nearly continuous grinding . . . heavier cuts can be taken . . . infeed or thrufeed methods can be employed . . . no centering or inspecting operations are necessary.

If it's accuracy, smooth finish, rapid production and lower grinding costs you're looking for, **it's Centerless all the way.**

Both Centerless and Center Type Grinders

Why not let us study your grinding problems to determine if the Centerless method can be applied? There's no obligation, of course.



CINCINNATI GRINDERS INCORPORATED

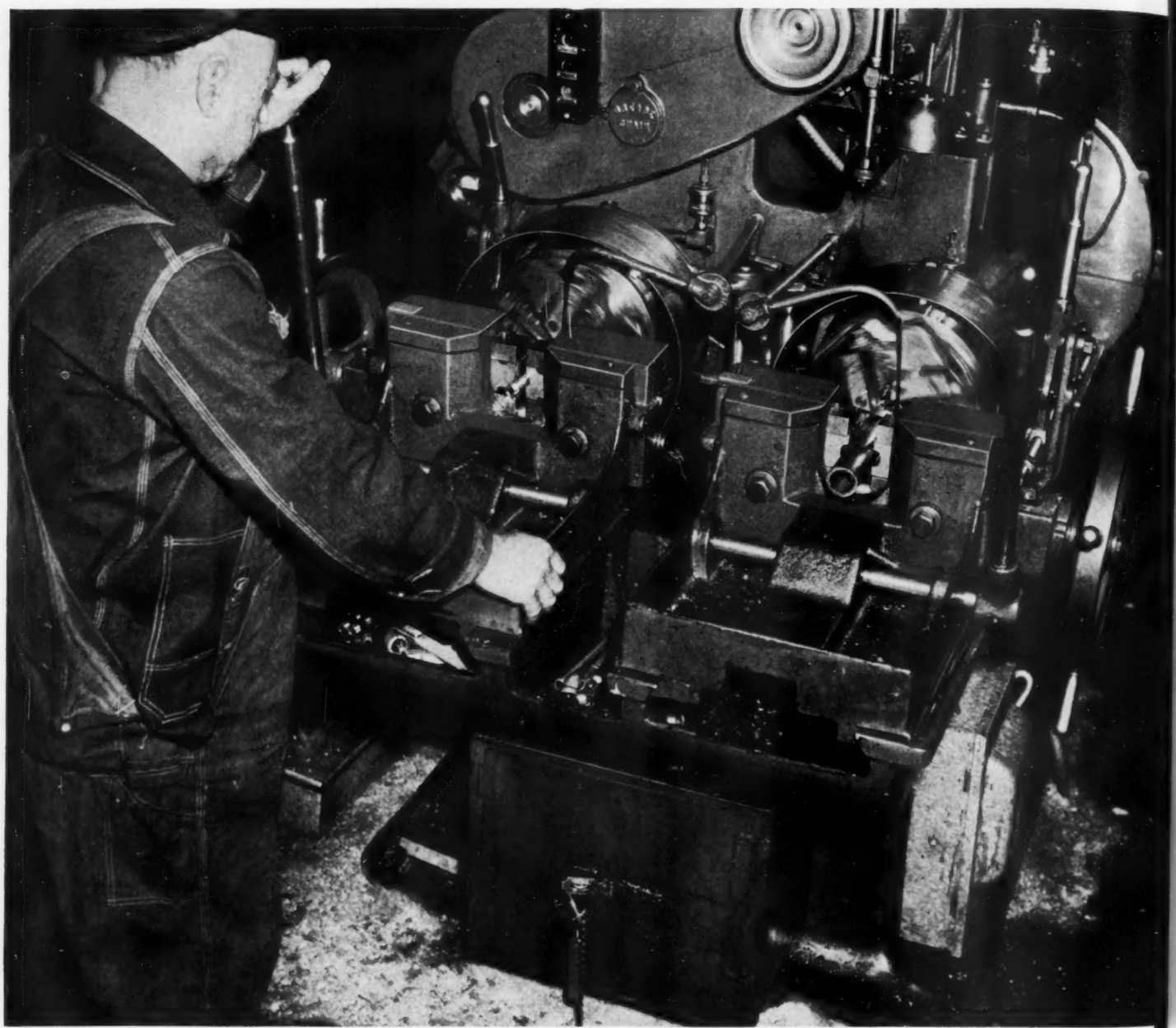
CINCINNATI, OHIO, U. S. A.

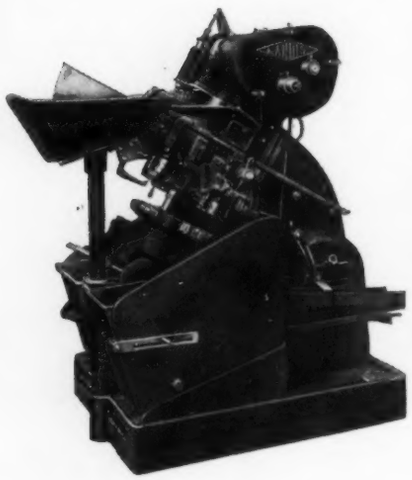
CINCINNATI

A SYMBOL OF A DEFINITE STANDARD OF WORTH

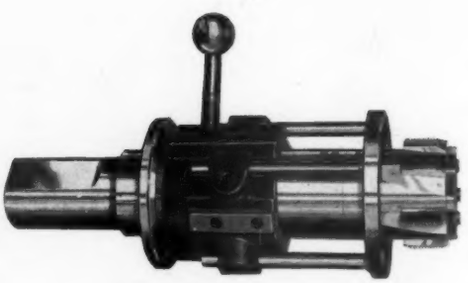
HOUR WHILE FINISH GRINDING

SAVE WITH A *New* CINCINNATI





LANDIS
Automatic
Forming and Threading
Machine



LANDIS Collapsible Tap

LANDIS

The Navy Yard

LANDISIZES

Threading and reaming of long red brass pipe nipples

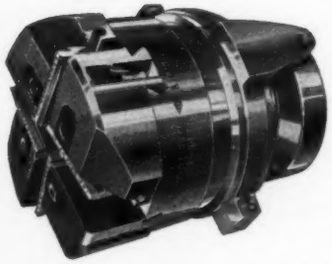
Up-to-the-minute performance and accurate pipe thread production are assured in the Brooklyn Navy Yard through the use of a modern Landis Pipe Threading Machine.

The machine — in service for the past year and a half — carries its share of the important work involved in the naval preparedness program. It handles the threading and reaming of Red Brass ½" and 1¼" tubing stock with precision and speed.

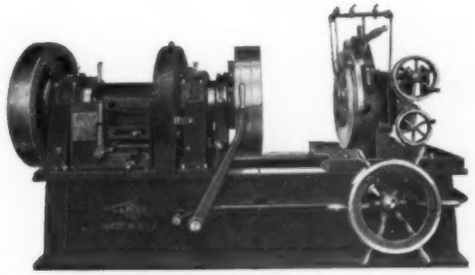
Modernization of all threading operations — for parts as well as pipe — is assured through the use of Landis Machines and Die Heads. There's a type and size for bringing your thread production up to date.

Investigate the savings you can make — the better quality threads you can produce faster and at lower cost—when you LANDISIZE your threads.

Complete information available on request.



LANCO Head for Hand Operated Threading Machines



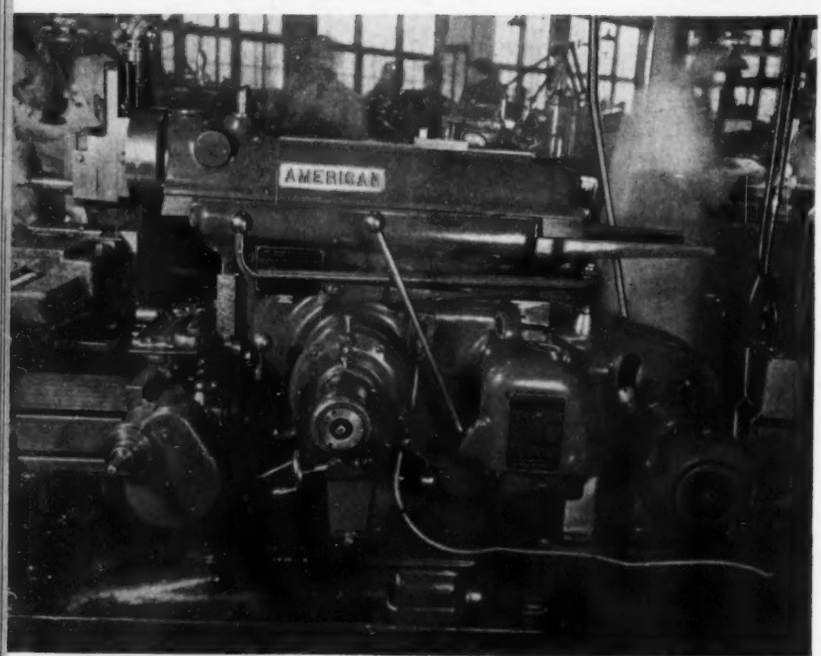
LANDIS Pipe Machine

MACHINE CO., Inc. WAYNESBORO, PENNA, U.S.A.

AMERICAN SHAPERS

typify

modernized production



THESE modern machines are recognized throughout the metal working industry for their ability to produce high quality work at low cost. Their acceptance by leading manufacturers in the industry is evidence of their proved ability as fast workers.

In addition to their capacity for heavy cuts, "AMERICAN" Shapers are accurate, versatile and easy to handle—advantages which have popularized their use in the most prominent tool rooms, die shops, mold plants and production departments.

Explore the possibilities for savings offered by "AMERICAN" Shapers. You'll find many reasons why these machines fit logically into modernization plans fully outlined in Catalog E—yours for the asking.

THE AMERICAN TOOL WORKS CO.

Cincinnati
Ohio

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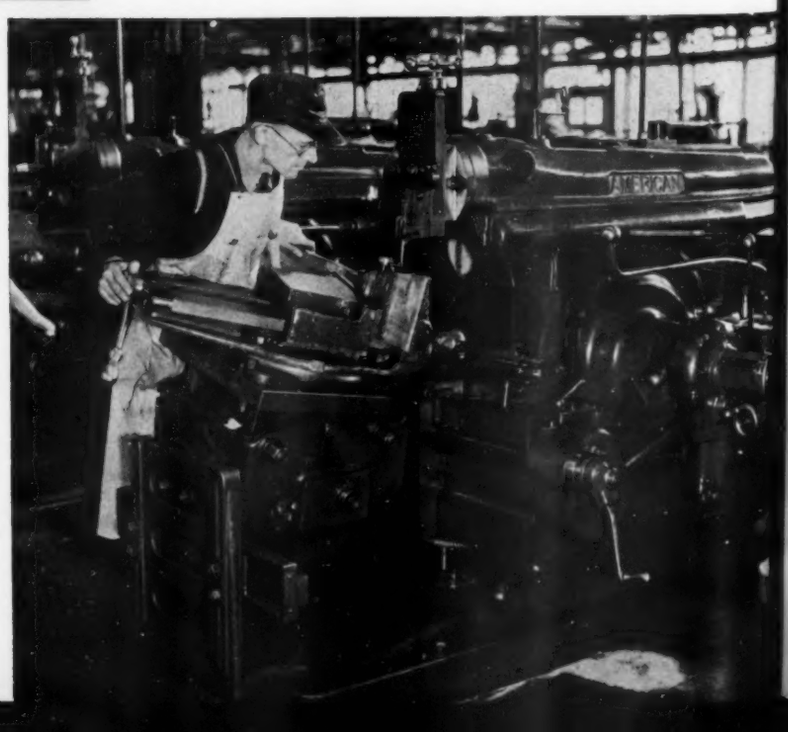
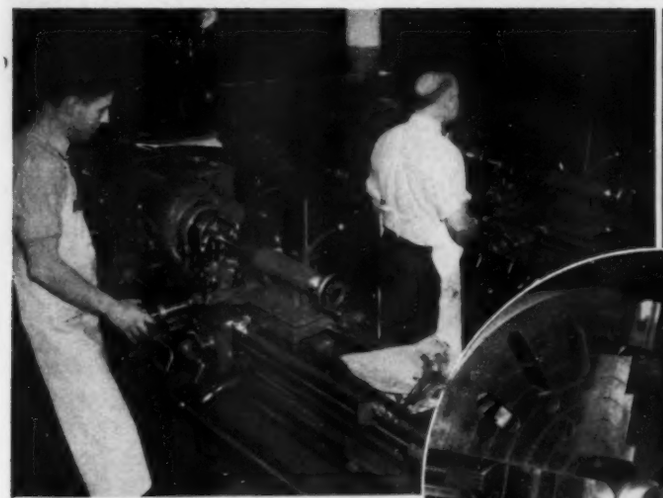
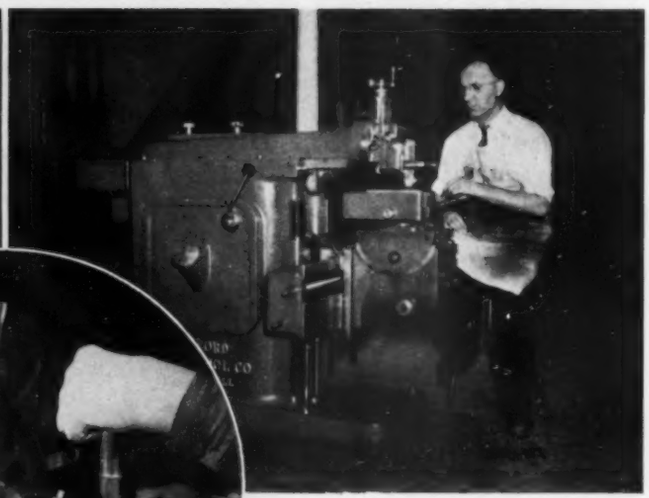
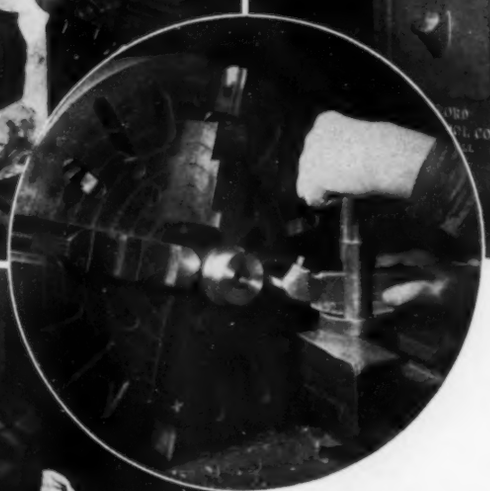
LATHES · RADIALS · SHAPERS



ARMSTRONG







Illustrations: (top) New Production Lathes and Shaper at Springfield Armory equipped with ARMSTRONG TOOL HOLDERS. (center and below) ARMSTRONG TOOL HOLDERS in Brooklyn Navy Yard.

Both the ARMY and the NAVY Use the ARMSTRONG SYSTEM

The "Armstrong System" that provides ARMSTRONG TOOL HOLDERS which "Save All Forging, 70% Grinding and 90% High Speed Steel", is being used in both arsenal and naval production. Springfield Armory's modernization program included an installation of two new lathes to supplement a battery of four to speed-up production of small arms. All the lathes are "tooled-up" with permanent multi-purpose ARMSTRONG TOOL HOLDERS—each equal to a complete set of forged tools. A shaper is similarly equipped.

At the Brooklyn Navy Yard Shops too, a program is under way to efficiently modernize and maintain the fleet. Orders call for fast, accurate and efficient metal cutting—with low tool costs. ARMSTRONG TOOL HOLDERS assured the success of their part of this program for they will stand up to any cut the machine tool can pull so cutting speeds and feeds can be stepped up safely.

No matter what your machining problem is, it has been worked out for you in the "Armstrong System" with its Tool Holders of over 100 sizes and shapes. Solve your *machining* problems with the right ARMSTRONG TOOL HOLDER—correctly designed, correct in proportion, in cutting angle and approach they give maximum strength with maximum clearance.

You can pick them up as needed from stock at your local supply house. Write for Catalog today.

ARMSTRONG BROS. TOOL CO.

"The Tool Holder People"

315 N. FRANCISCO AVE., CHICAGO, U. S. A.

Eastern Warehouse and Sales: 199 Lafayette St., New York • San Francisco • London

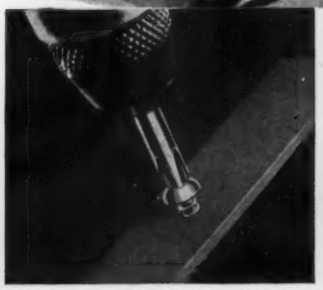
Buy ARMSTRONG TOOLS from your Supply House

ARMSTRONG TOOL HOLDERS Are Used in Over 96% of the Machine Shops and Tool Rooms

They Call Him the "ONE MAN GANG"

PHILLIPS RECESSED HEAD SCREWS GIVE HIM THREE HANDS . . APPROXIMATELY DOUBLE THE PRODUCTION LIGHTEN HIS EFFORT REQUIRED CUT DOWN HIS REJECTIONS

THE SCREW CLINGS TO THE DRIVER . . . so he has one hand free to hold the work.



POWER DRIVING SPEEDS UP HIS WORK . . . there is no danger of driver slippage.

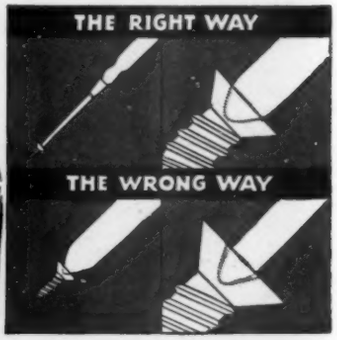
TRIPLE CONTACT WITH THE DRIVER . . . reduces the driving effort required.

SCREWS ARE DRIVEN HOME SAFELY . . . because Phillips Screw heads won't split.

YOU WOULDN'T PLAY EVERY SHOT WITH ONE DRIVER

Shape, taper and depth of the genuine Phillips recess were determined after thousands of tests. The recess utilizes the driver's maximum turning power without sacrifice of strength in the screw head . . . without danger of shearing the metal.

For efficient driving, contact between recess and driver should extend as far as possible from the screw's axis. On the other hand, too big a driver means stripping threads or tearing fibre structure of wood or metal. Thus it requires four driver sizes to drive properly the entire range of recessed head screws. Two sizes of Phillips Drivers handle diameters #5 through #16 or approximately 85% of all screws driven.



PHILLIPS *recessed head screws*

MACHINE SCREWS · SHEET METAL SCREWS · WOOD SCREWS · STOVE BOLTS

U. S. Patents on Product and Methods Nos. 2,046,343; 2,046,837; 2,046,839; 2,046,840; 2,062,065; 2,084,078; 2,084,079; 2,090,338. Other Domestic and Foreign Patents Allowed and Pending.

This Booklet will help your plant to cut fastening costs and improve assemblies. Address one of the firms below for free copy.

American Screw Co., Licensor, Providence, R. I.
Chandler Products Company, Euclid, Ohio
Continental Screw Co., New Bedford, Mass.
Corbin Screw Corporation, New Britain, Conn.
The Lamson & Sessions Co., Cleveland, Ohio
National Screw & Mfg. Co., Cleveland, Ohio
Parker-Kalon Corporation, New York, N. Y.
Pheoll Manufacturing Company, Chicago, Illinois
Russell, Bardsall & Ward Bolt & Nut Co., Port Chester, N. Y.
Scovill Manufacturing Co., Waterbury, Conn.

IT COSTS LESS TO USE PHILLIPS SCREWS

Why Anti-Friction Bearings?

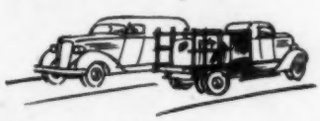
BECAUSE wherever wheels or shafts turn in modern machinery, anti-friction bearings do these 10 things:

1. Reduce friction . . . . . .

2. Reduce wear . . . . . .

3. Prolong life of machinery . . .

4. Increase accuracy . . . . . .



5. Reduce maintenance . . . . . .

6. Resist loads from all directions.

7. Permit high speed operation . .

8. Simplify design . . . . . .

9. Allow accurate inter-changeability.

10. Give assured performance . . .

These are the reasons for using anti-friction bearings . . . for using *ball* bearings . . . for using New Departure ball bearings.

New Departure, Division General Motors Sales Corp., Bristol, Conn.

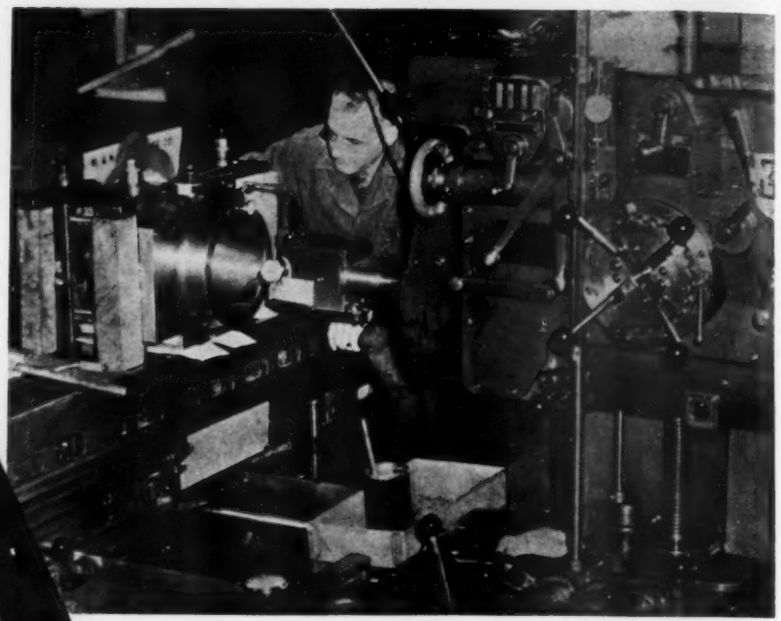
NEW DEPARTURE

BALL BEARINGS

Nothing Rolls Like a Ball

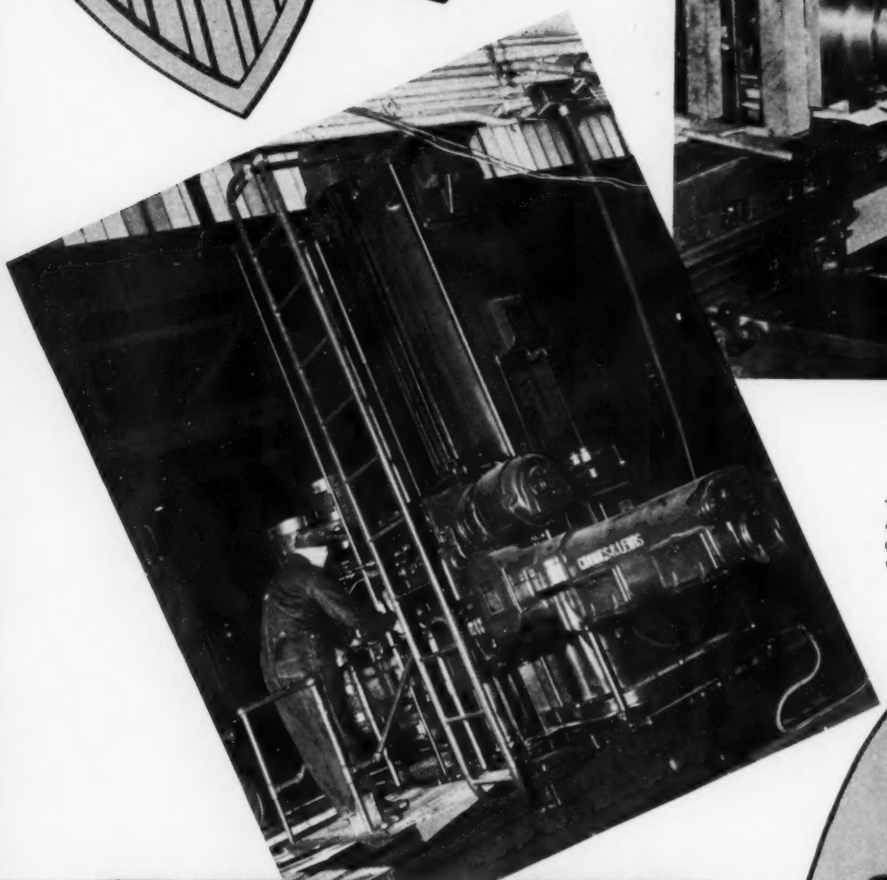
2772

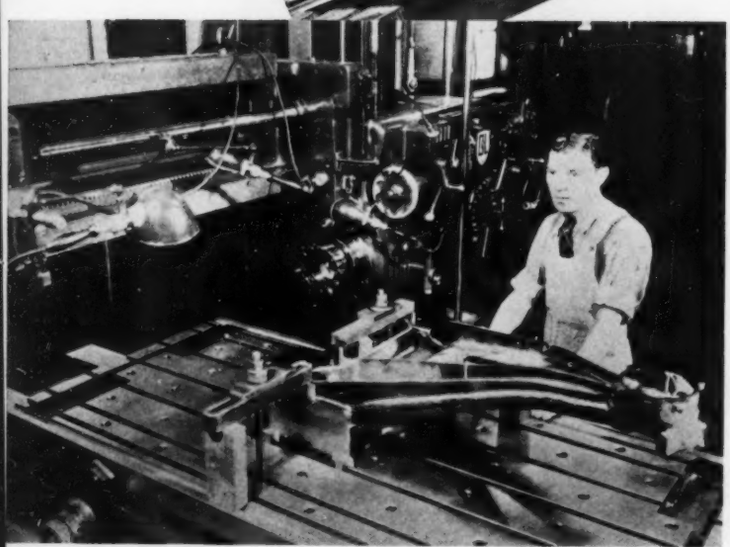
★★★★ YOUR FIRST



★ This G & L in use at the Springfield Armory is used on a variety of instrument work, usually on small lot production jobs with a number of special attachments.

★ A No. 350 FQ G & L horizontal boring, drilling, and milling machine at the Brooklyn Navy Yard, used on such important elements for fighting ships that the work itself cannot be shown.





★ Another view of the G & L at the Springfield Armory with a special milling attachment in place, machining a welded yoke for an anti-aircraft gun mount.

3

EXAMPLES OF G&L HORIZONTAL BORING MILLS PERFORMING VITAL OPERATIONS FOR UNCLE SAM'S FIGHTING FORCES

THE MORE G & L USERS ------

LINE OF DEFENSE ★★★★

AGAINST LOSS OF PROFIT···*because*

YOU GET ACCURACY AND SPEED WITH NO TOOL SPOILAGE··ELIMINATION OF WORK SPOILAGE···NO OPERATOR FATIGUE

Here are some of the reasons why!

***Time saving with* DEPTH GAGE**

This device eliminates considerable measuring on the part of the operator and also eliminates the necessity of constant watchfulness. This results in greater speed and ends the possibility of mistakes. Rotation of the turnstile rapid traverses either the main or high speed spindle by hand. A pull on any one or several of the turnstiles engages the power feeds—a push on top disengages them.

***Greater accuracy with* SCALES *and* ADJUSTABLE VERNIERS**

No climbing over headstock to read scales set in column—this means safety—saves time—and insures greatest accuracy. The table and headstock movements are each provided with a precision scale. The verniers are graduated to read in .001" and are adjustable so that they can be set to the nearest full inch for a starting point, eliminating a lot of decimal figuring.

***The operator can be sure with* DIRECT READING DIALS**

Beneath the cover plates, geared to the rotary selectors, are dials which, through openings, show the spindle speed or feed engaged. While cranking, the operator merely watches the window until the speed or feed wanted appears. Here again is accuracy and savings in time.

***Set-up changing saved with* ROTARY TABLE**

Mounted on machine table—either hand or power feed—makes it possible to do any operation on any of the four sides of a casting simply by revolving the table—the set-up of the casting remains the same—a real time saver.

***Accuracy and speed thru* HAND ADJUSTMENT**

A slow hand feed with micrometer adjustment is applicable to spindles through a hand wheel at front of head. This hand adjustment of spindles is one of the many G & L features that pay in larger profits.

GIDDINGS & LEWIS MACHINE TOOL CO.

FOND DU LAC, WISCONSIN

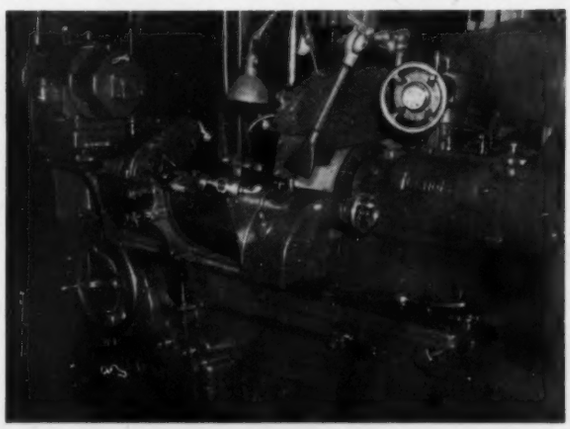
★ BORING
★ DRILLING
★ MILLING
MACHINES

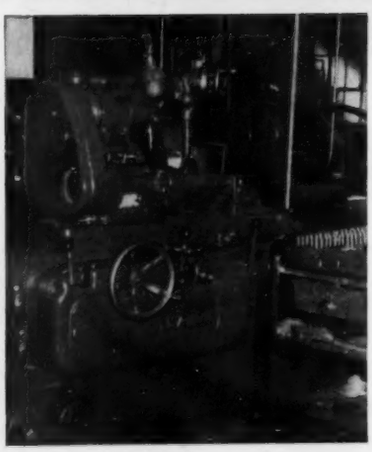
····THE MORE G & L BOOSTERS

PLANE

at Curtiss-Wright—

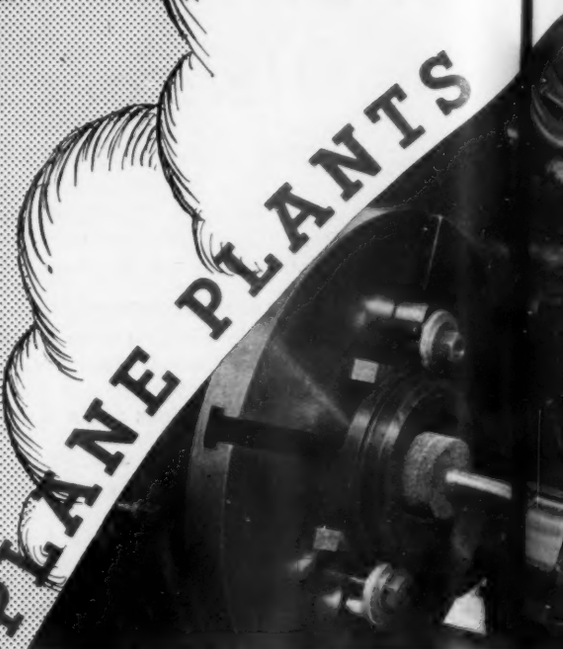
AT MANY AIRPLANE PLANTS





Grinding OD of propeller shaft on 20" x 72" Type D Plain Hydraulic.

Grinding tactiometer drive gear shaft on 6" x 18" Type C Plain Hydraulic.



Internal grinding bore of piercing die on 14" Type C Hydraulic Universal.

Grinding radial air cooled airplane cam on Type C Radial Cam Grinder.

Internal grinding airplane landing gear part on 14" Type C Hydraulic Universal.

WE illustrate on these two pages a group of plane facts. That is to say we show you many different parts which are being ground on Landis equipment in some of the world's largest airplane plants. The views above were taken at the large Patterson Plant of the Curtiss-Wright Corporation. Numerous other Landis grinders are found in the plants of this organization. The views to the right are typical of the operations being performed on Landis equipment in airplane manufacture generally. All of which leads us to, with confidence, suggest that you come to Landis with your grinding problems whether you contemplate expanding your facilities or wish to improve both quality and quantity of output. Nothing could recommend Landis equipment for the exacting requirements of airplane manufacture any more than the present wide usage of these machines by that industry. 292

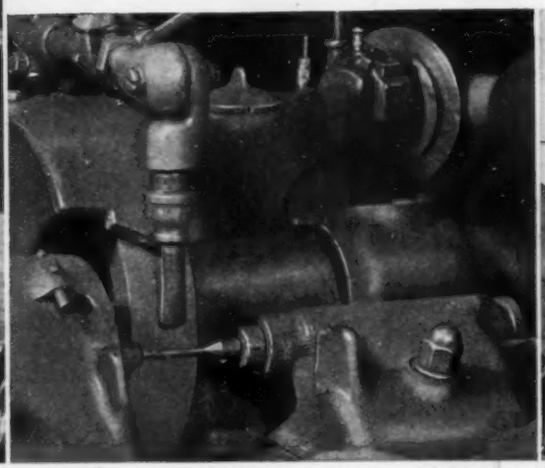
LANDIS TOOL COMPANY
WAYNESBORO, PENNA.

FACTS

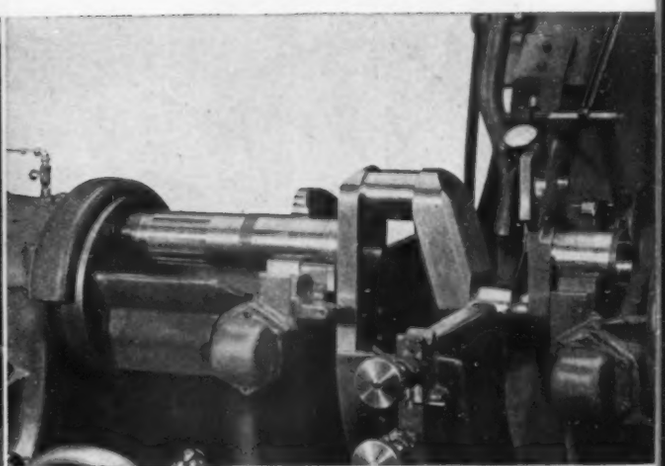
THROUGHOUT THE WORLD

Relieving piston on Hydraulic Piston Grinder.

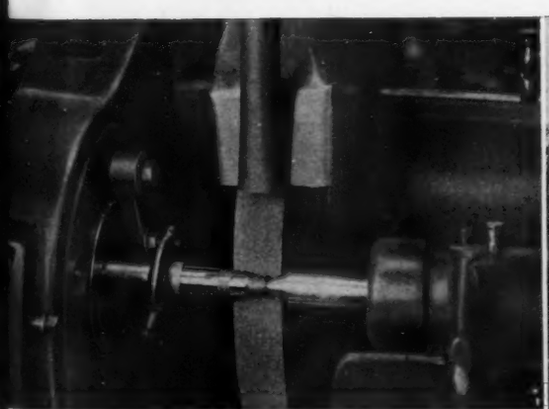
Grinding air screw shaft trunions on 14" Type C Universal raised to swing 38".



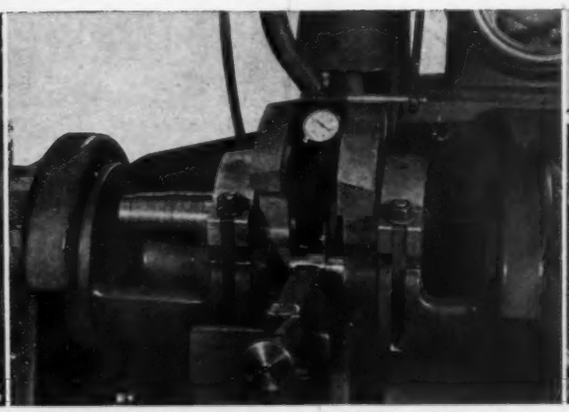
Grinding aircraft cable eyes on a 6" Plain Machine.



Grinding pins of double radial airplane engine shaft on a 20" Type D Hydraulic Crank Pin Grinder.

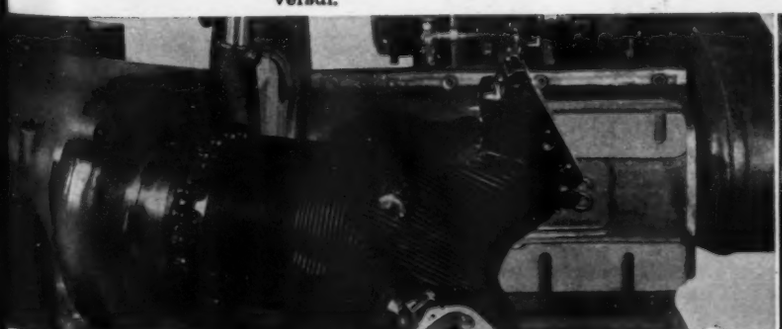


Grinding taper end of cam pinion shaft on 14" Type C Hydraulic Universal.

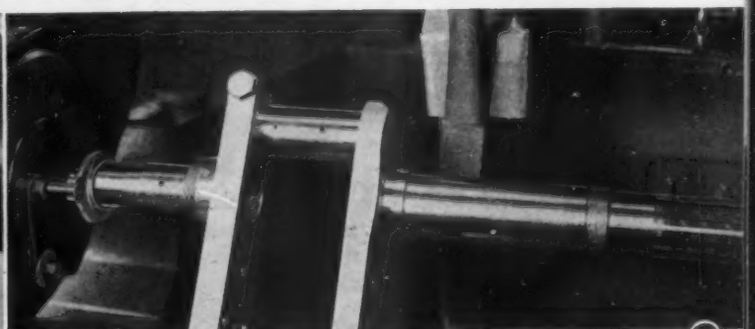


Finish grinding pin of assembled crankshaft on 25" Type D Hydraulic Crank Pin Grinder.

Grinding pin and fit of crankshaft front end on 25" machine.



Grinding shoulder and flange of radial airplane cylinder on 14" Type C Universal raised to swing 20".



Finish grinding main bearings of assembled radial airplane engine crankshaft on 14" Type C Hydraulic Universal.

Your Drill Problems Solved

(in one easy lesson) with

Thor Electric Drills

"TAKE A TIP, FELLAH! My new Thor Drillmaster has saved me money every day. For maintenance and light-duty work there isn't a tool in the running with it in its price class."

THE THOR DRILLMASTER **$19.95**
¼" capacity drill for all-around, light-duty work. The low-priced drill that brings Thor quality within the reach of every tool user . . . you get Economy and Performance at one low cost.

THE THOR U14A.... ....**$32.50**
¼" capacity drill for hard production service. Small, light and sturdy . . . with the power of tools *twice* its size.

"FOR YEARS AND YEARS we've been cutting costs with the Thor U14A. It's the pioneer of small, light-weight production drills."

Thor offers more!

IN
PORTABLE ELECTRIC TOOLS

INDEPENDENT PNEUMATIC TOOL COMPANY • 600 WEST JACKSON BOULEVARD • CHICAGO, ILLINOIS

BIRMINGHAM • BOSTON • BUFFALO • CLEVELAND • DETROIT • LOS ANGELES • MILWAUKEE • NEW YORK • PHILADELPHIA • PITTSBURGH • ST. LOUIS • SAN FRANCISCO

"NOW YOU'RE *Talking* MY LANGUAGE!"

THE smart lathe operator knows that he has a partner on a job—that he and his machine produce together as a unit. He knows that he's on a spot if his lathe cannot produce the quality and volume of work that he could turn out on a better machine.

But give him a new Monarch—and you'll see *team work* of the highest caliber—you'll agree that a good man and a good machine make an unbeatable combination.

Make this test today. Tell the man who is trying hard but falling down on the job that he will work on a Monarch lathe from now on. Watch his face light up in a smile of appreciation. Hear him say: "Boss, you're talking my language."

MONARCH COVERS THE TURNING FIELD
and includes:
AUTOMATIC SIZING
Magna-Matic LATHES
5-T MANUFACTURING LATHES
MODEL "C" TOOL ROOM LATHES
10" SENSITIVE PRECISION LATHES
MONARCH KELLER LATHES
ENGINE LATHES
Write for Catalogs.

Modernize With Monarch!

THE MONARCH MACHINE TOOL CO., Sidney, Ohio, U.S.A.

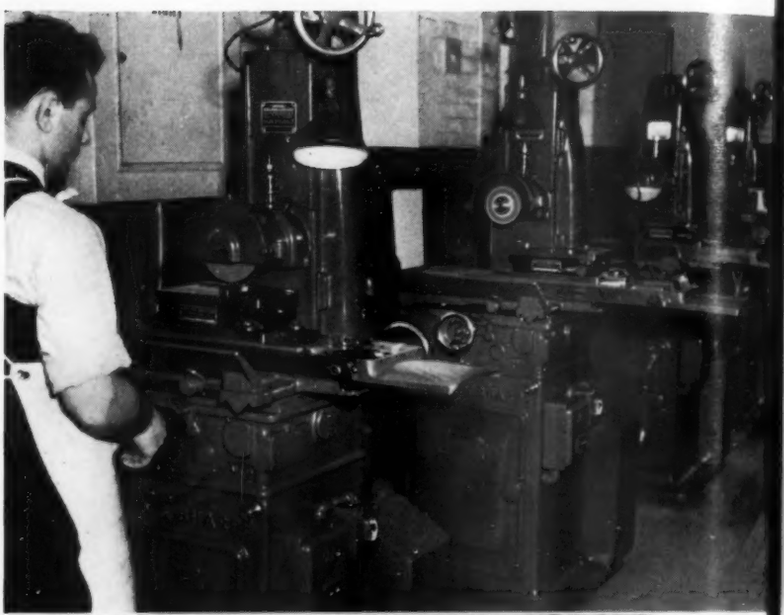
MONARCH LATHES
COVER THE TURNING FIELD

Chicago Sales Office: 622 West Washington Boulevard. • Indianapolis Sales Office: 3115 North Meridian Street. • Newark Sales Office: 1060 Broad Street. • Pittsburgh Sales Office: 604 Chamber of Commerce Bldg. • *Agencies in principal industrial centers of this and foreign countries.*

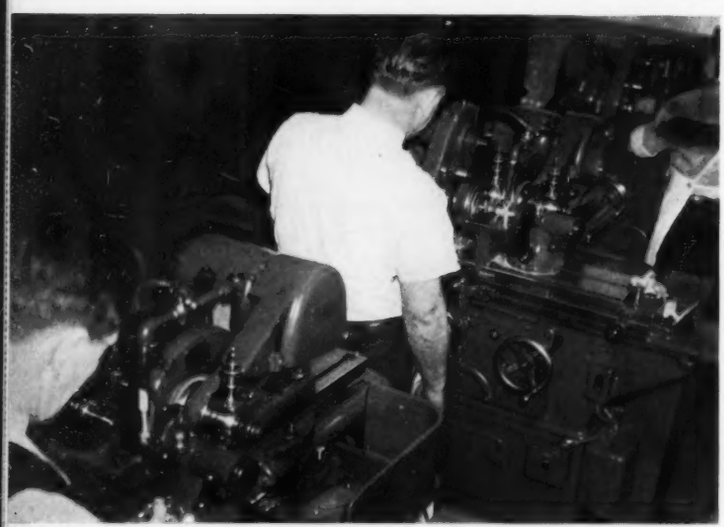
HELPING in the PROGRAM

GRINDING MACHINES

Grinding operations, too, performed on Brown & Sharpe Grinding Machines, meet the high standards for precision set in the toolrooms of the Government Arsenals. On work of this nature there can be no compromise with accuracy. The entire line of Brown & Sharpe Grinding Machines is consistent in ability to adhere to closest toolroom and manufacturing limits of precision.



Right—Battery of 4 Brown & Sharpe No. 2 Surface Grinders and close up of one of these units equipped with Brown & Sharpe Magnetic Chuck, Permanent Magnet Type, in the toolroom of the Springfield Arsenal.

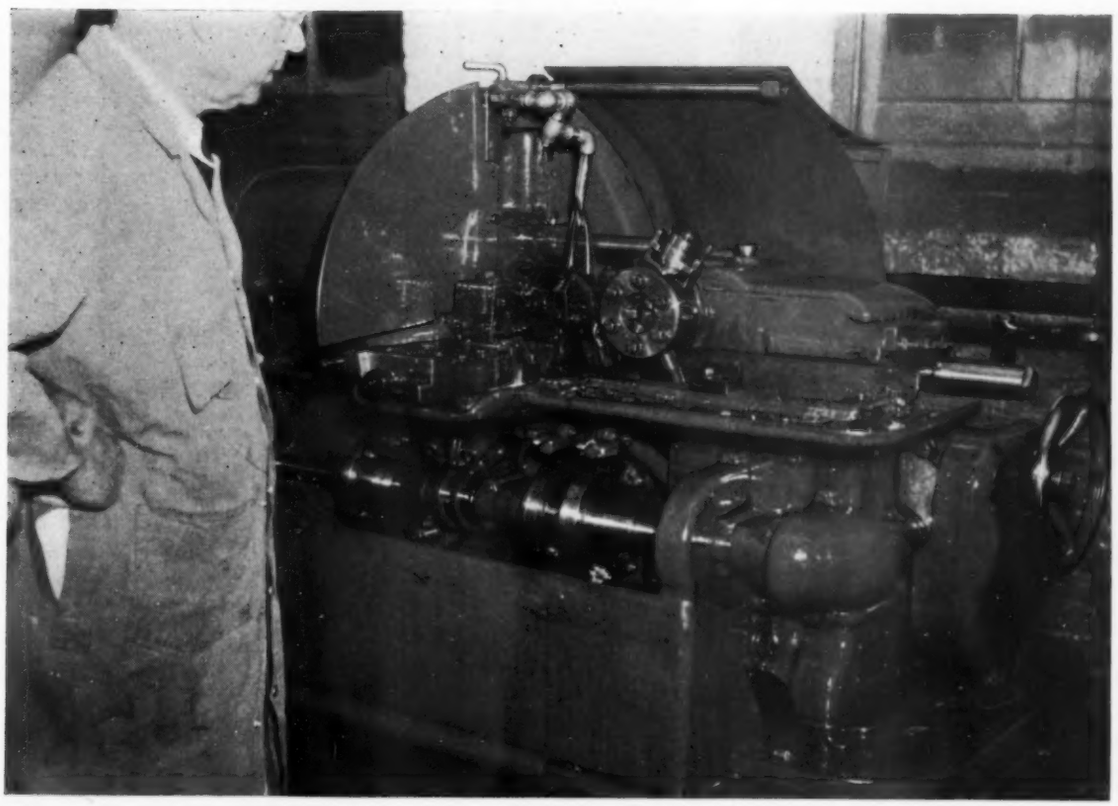


Above—Brown & Sharpe No. 1 Universal Grinders in the Springfield Arsenal Toolroom.

BROWN &

M OF NATIONAL DEFENSE

SCREW MACHINES



New No. 141 Catalog
lists the entire line—
copy sent on request
BROWN & SHARPE MFG. CO.
Providence, R. I. U.S.A.

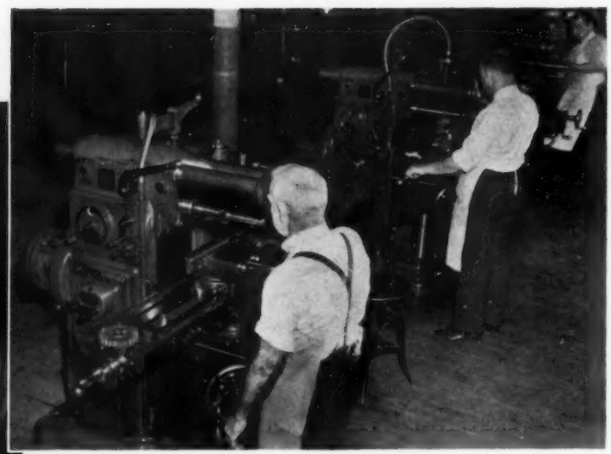
Ability to produce fast and maintain accuracy is characteristic of Brown & Sharpe Screw Machines. Arsenals take advantage of this typical kind of performance in screw machine part production. The No. 2G Brown & Sharpe Automatic Screw Machine shown is performing turning, forming, threading and cutting-off operations on WD1120 Stainless Steel Stock parts 3¼" long at the Springfield Arsenal.

B·S

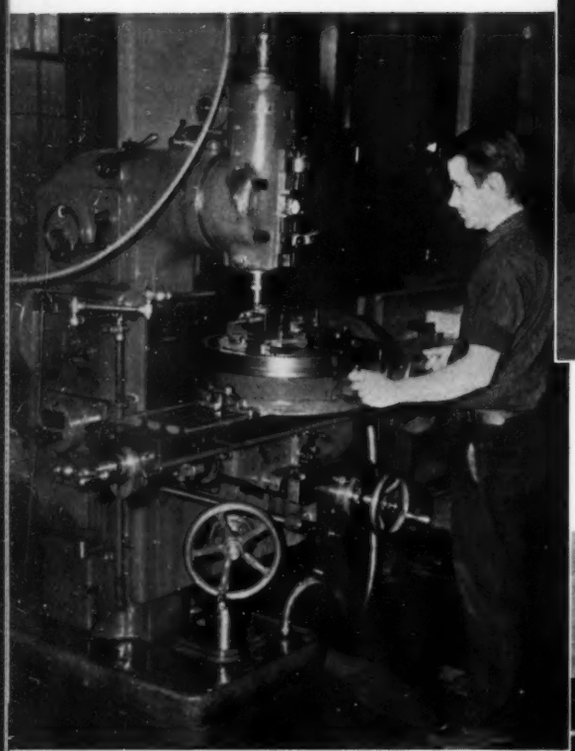
G SHARPE

HELPING in the PROGRAM

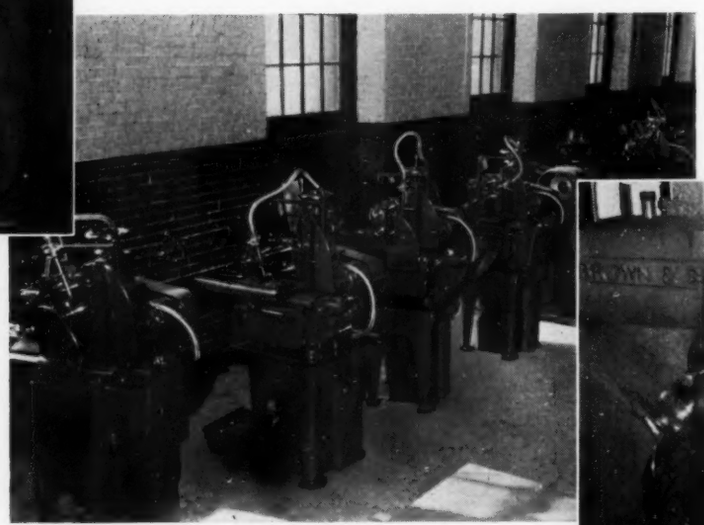
MILLING



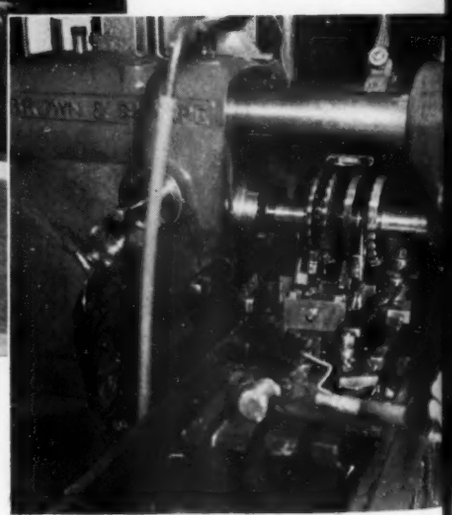
Left—A battery of 3 Brown & Sharpe No. 2 Light Type Universal Millers in the Hill Shop Toolroom of the Springfield Arsenal.



Below—Battery of No. 000 Brown & Sharpe Plain Milling Machines helping in the program of national defense at the Springfield Arsenal.



Above—One of a battery of new Brown & Sharpe No. 2 Light Type Vertical Milling Machines in the Springfield Arsenal used in the manufacture of 30 calibre rifles.



Above—A Brown & Sharpe No. 12 Plain Milling Machine performing a milling operation on a trigger housing.

In the extensive use of Brown & Sharpe Milling Machines at Government Arsenals, advantage has been taken of the many modern features incorporated in these machines to speed work and cut costs on tool room and production operations.

Modern plants in all branches of the metal working industry accept the name Brown & Sharpe as standing for *quality*—in the machines themselves and in the work they produce.

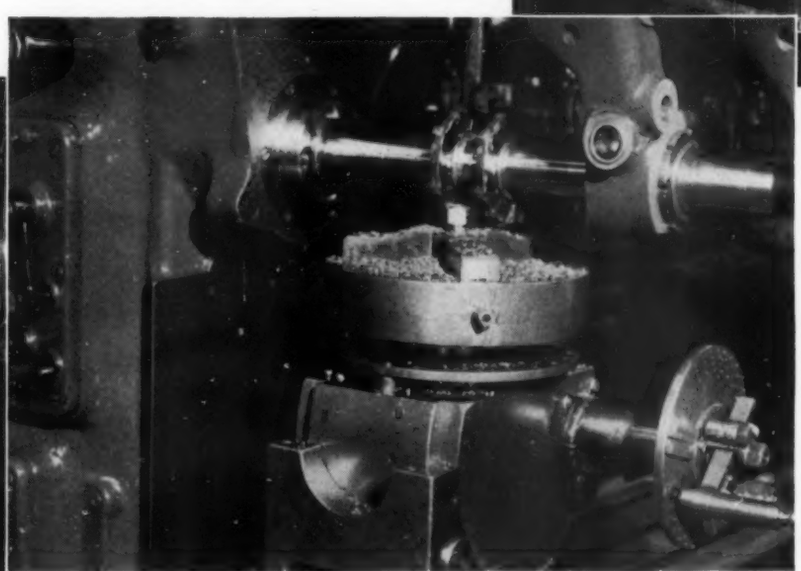
BROWN &

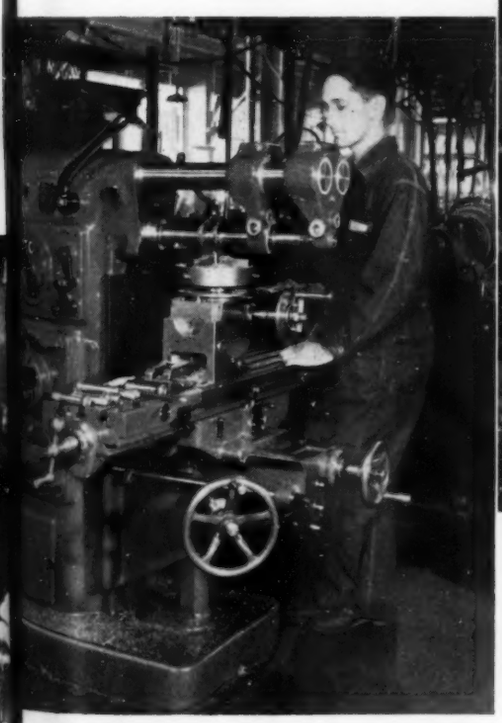
OF NATIONAL DEFENSE

MACHINES

Navy Yards, too, are *quality* conscious. In their program of modernization to meet the stepped up production requirements of national defense, Brown & Sharpe Milling Machines play a conspicuous part. The fact that modern Brown & Sharpe machines are available in a broad range of sizes and types is assurance that advantage can be taken of the many advanced features offered to cut costs on practically any milling operation.

Right—A No. 2A Brown & Sharpe Universal Milling Machine—Dual Control Type—cutting tool steel in the shops of the Brooklyn Navy Yard.

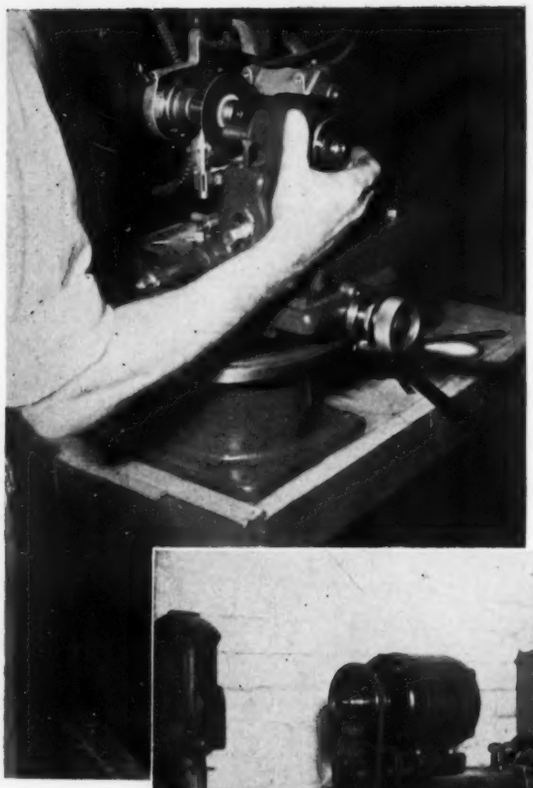




Above—These views show a Brown & Sharpe No. 2 Light Type Milling Machine at work in the Boston Navy Yard shops.

B·S

SHARPE

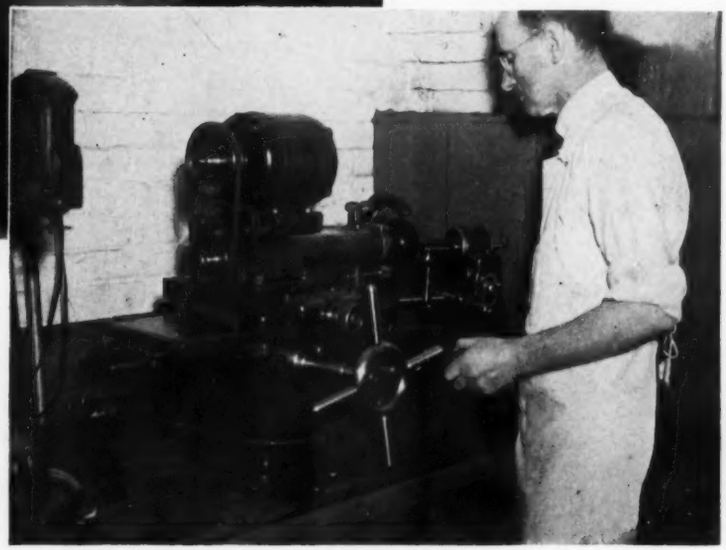


The simplicity and clean-cut design of the Union Bench Grinder appeal at once to men who know their "stuff."

UNION TOOL GRINDERS

"go" places at

Springfield Arsenal



This is a fuller view of the grinder (see close-up above). It occupies little bench space to do a real man-size job. Note convenience of controls.

The Tools you buy again!

Three small Union Tool Grinders—all like this—are making themselves more than "generally useful", at Springfield Arsenal.

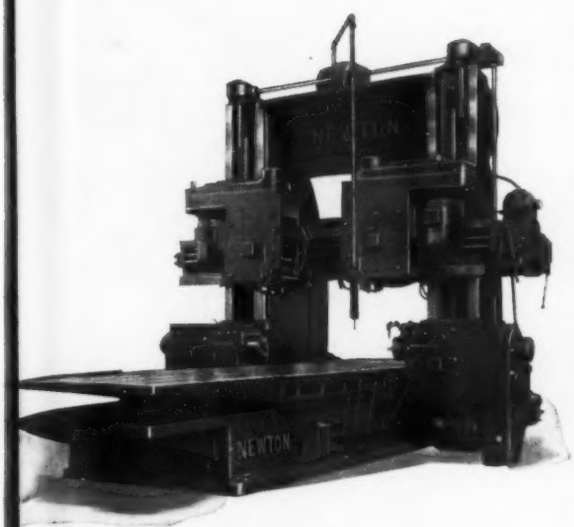
Their accuracy, speed, ease of handling and versatility commended them to Army men. Send for facts.

UNION

TWIST DRILL COMPANY, ATHOL, MASSACHUSETTS

INDUSTRY'S FIRST LINE OF DEFENSE—

MODERN MACHINE TOOLS

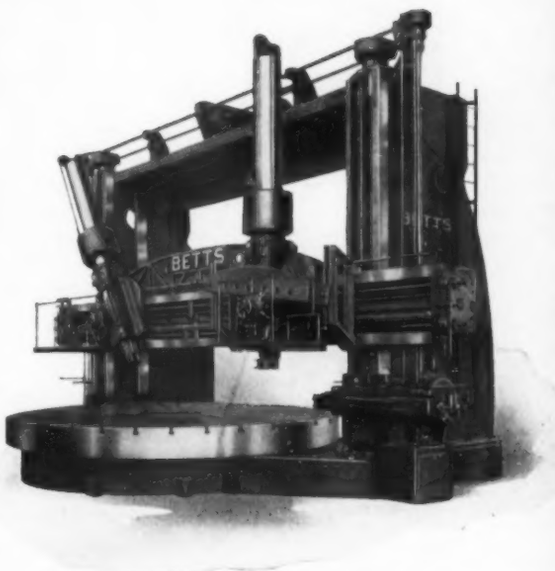


NEWTON Unit Head Box Type Milling Machine. Built in all sizes with any number of heads and spindles.

Follow the example of our Army and Navy by initiating a defense program of your own.

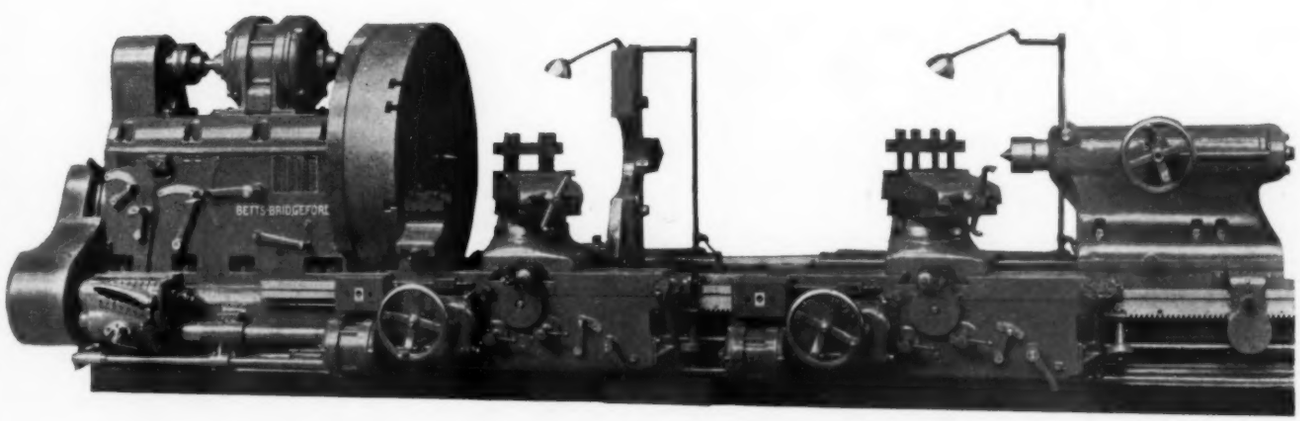
Remember, that just as our national defense looks to industry, so must industry look to its own first line of defense—Machine Tools.

Consolidated Machine Tools are contributing in great measure to those successful manufacturing plants that have learned the first step to profit is accurate, speedy, low cost machining operations.



COLBURN and BETTS Boring Mills are built in sizes from 42" up to practically any requirements.

Three Consolidated cost-cutting tools are shown here but they are only three out of a complete line of metal working machine tools for turning, boring, drilling, milling, cutting, bending, punching and shearing—machine tools that can build up your defenses and put you in an impregnable position to take care of the big market opened up by our national defense program. Consult us on your machine tool needs.



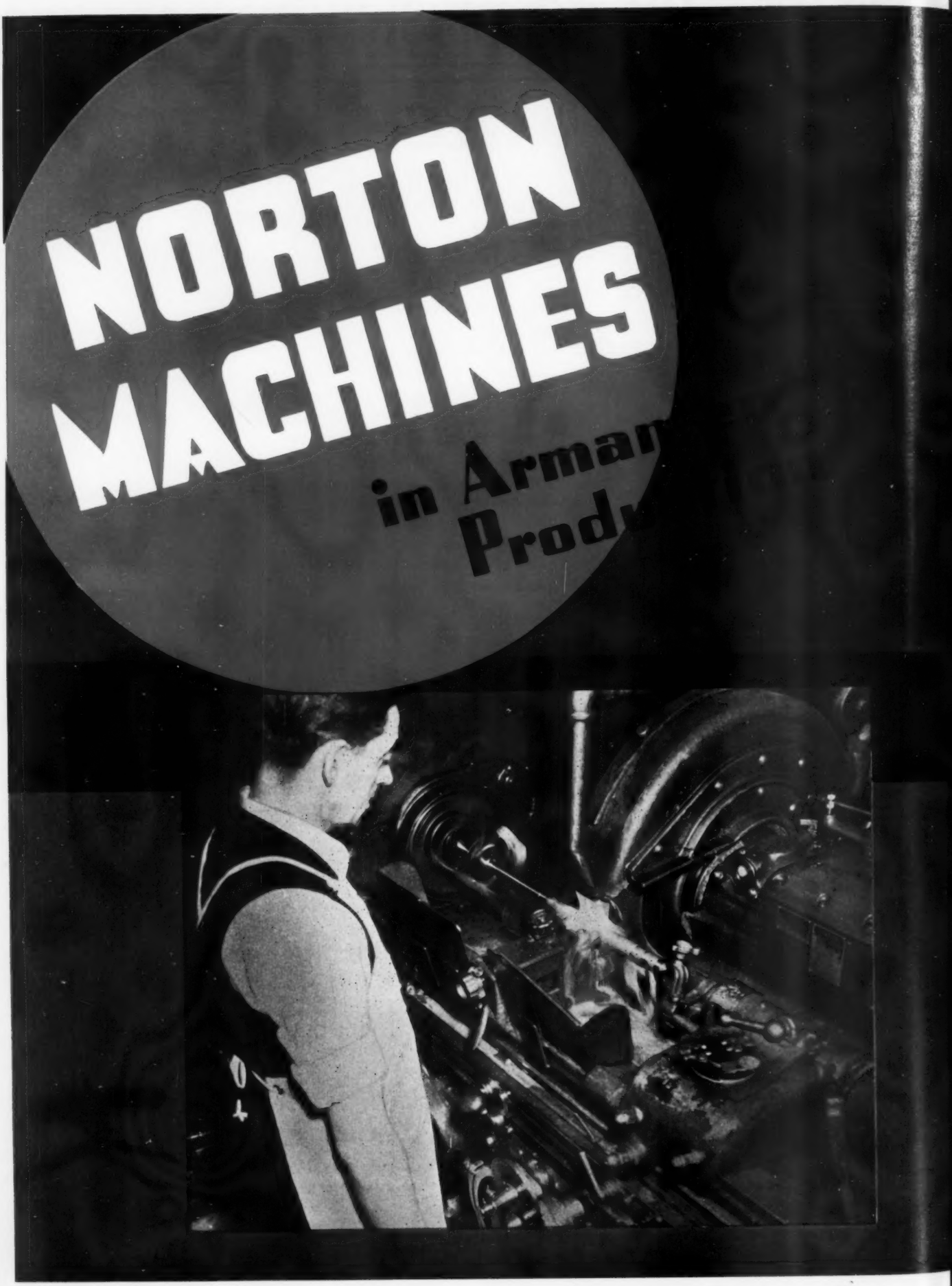
BETTS-BRIDGEFORD 60" HEAVY DUTY GEARED HEAD LATHE

Built in sizes from 26" up to practically any requirements

BETTS • BETTS-BRIDGEFORD • NEWTON • COLBURN • HILLES & JONES • MODERN

CONSOLIDATED MACHINE TOOL CORPORATION

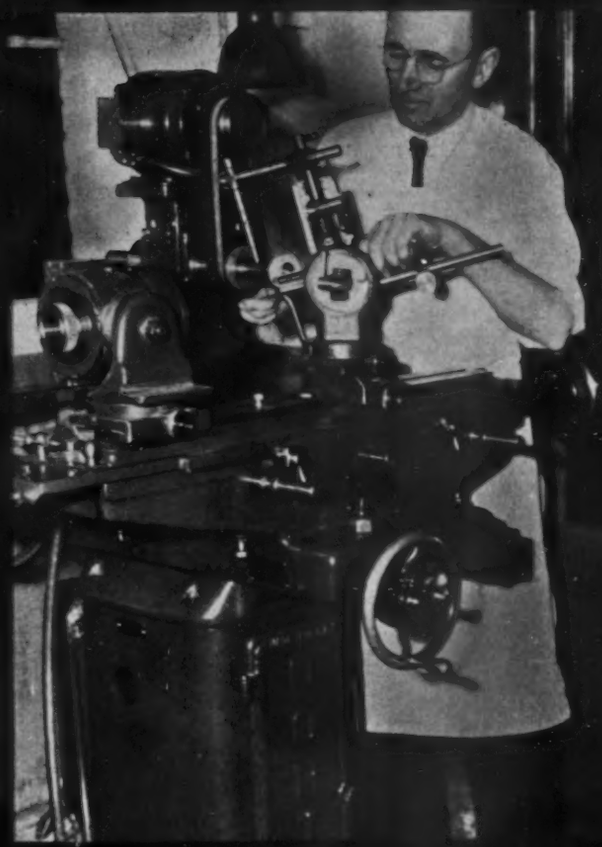
ROCHESTER, NEW YORK


NORTON
MACHINES
in Armam
Produ

The illustration on the opposite page shows a Norton Type C Machine in the Forming Department of the Springfield Arsenal—a typical example of the kind of high production, high precision jobs for which the Type C is famous. It is available in 6″, 10″, 14″ and 16″ swings and a variety of lengths in each; in plain and semi-automatic arrangements.

For heavy ordnance jobs there is a complete line of Type D machines in 20″, 24″, 28″, 32″ and 36″ swings, and they have been furnished in lengths as long as 480″ between centers.

Norton No. 1 Universal Tool and Cutter Grinders are used at Springfield not only in the tool room (illustration at right) but also in the production department for light cylindrical operations.



NORTON ABRASIVES

To meet tool room requirements B-E bond wheels are recommended for high speed steels, green Crystolon and diamond wheels for cemented carbides and mounted points for die grinding.

B-E bond wheels are also especially suitable for the many high-production-precision cylindrical jobs in armament manufacture.

For snagging operations in the foundry there's a complete line of Norton wheels in Alundum abrasive for steel castings and Crystolon abrasive for gray iron—resinoid, rubber and vitrified bonded.

NORTON COMPANY, WORCESTER, MASS.

To the Man who says,

HERE'S PROOF!

"We make cold pressed nuts. With the steel formerly used, we processed from 4000-8000 lbs. of nuts per day. Last month, using U·S·S Controlled Steel, our records show we processed from 8000-11,000 lbs. per day, about the maximum that can be obtained on our machines. Have about doubled our output. Our production jumped 700% between tool settings.

"On one set of dies we formerly processed 10 to 20 tons of material. We now process 140 tons. 400 to 3000 nuts was the best we could get with one punch—now we get 20,000. Do you wonder we're enthusiastic about U·S·S Controlled Steels?"

MORE PROOF!

"We make connecting rods, cams, front axles and other automotive forgings. Ease of forging, well-filled sections, and uniformity in heat treatment are advantages that U·S·S Controlled Steels have shown in our plant. Freedom from trimmer cracks and quench cracks, together with marked toughness after heat treating, is also imparted by these steels. So is definite control of hardness from center to outside of each product. By using U·S·S Controlled Steels and our special agitating equipment, we've minimized the scale effect on hardenability, and in addition have materially reduced cleaning costs through this freedom from scale."

STILL MORE PROOF!

"We make screw machine parts. We supply an infinite variety of specialty products to fabricating shops, whose requirements are both specific and different. Our cold drawn steel requirements are rigid from the standpoint of machinability, finish, and uniformity of physical characteristics. When our products are subjected to heat treatment, they must have uniform properties, which can only be secured by careful control in the manufacture of the steel. So, in buying cold drawn bars, we specify U·S·S Controlled Steels—both Open Hearth and Bessemer—to provide the uniformity so essential in keeping our customers satisfied."

UNITED

"You'll have to show me"

WE INVITE consideration of the following cases, typical of hundreds in our files—

. . . A manufacturer making nuts and bolts formerly changed drills 3 times every 8 hours. Using U·S·S Controlled Steel he now runs 26 hours straight, without change—drills last 9 times as long.

. . . A prominent manufacturer of an automobile specialty specifies coarse grain structure for one size, and fine grain for another—and gets it in U·S·S Controlled Steel. Now obtains uniformly hardened structure with a single standardized heat treating schedule.

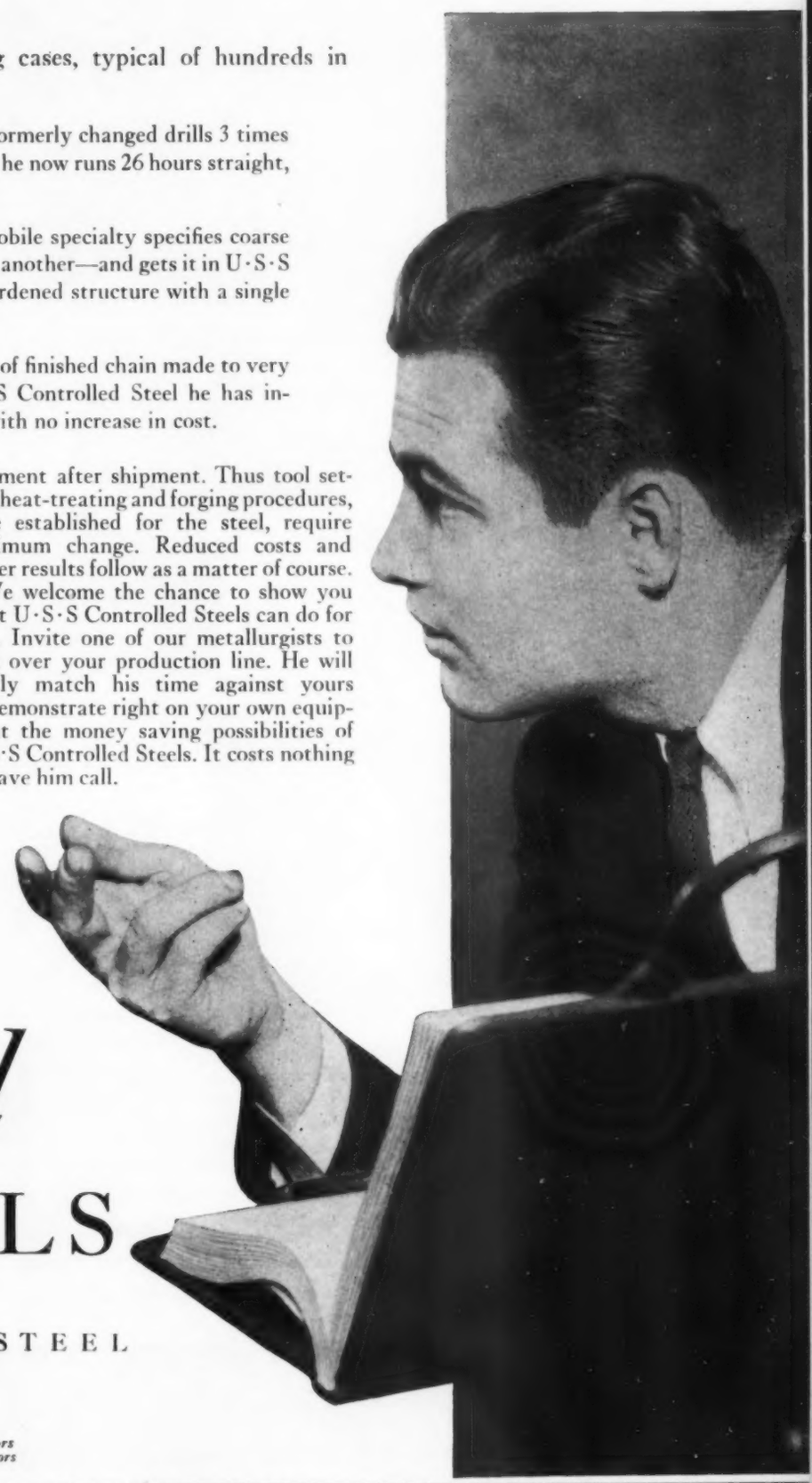
. . . A chain manufacturer is reeling up miles of finished chain made to very restrictive physical properties. With U·S·S Controlled Steel he has increased physical properties at least 25%—with no increase in cost.

These users, too, were from Missouri when we first introduced U·S·S Controlled Steels. Today in their shops and many others, combined cost reductions run into hundreds of thousands of dollars yearly. Do you wonder they swear by these superior carbon steels?

In U·S·S Controlled Steels, control goes further than the mere close adherence to chemical specifications. It has to do with control of other vitally important properties—forging and machining qualities, response to heat treatment, ductility, etc.—which so largely determine whether production in the user's plant will be wasteful or economical.

In U·S·S Controlled Steels we have proved it quite possible to furnish not only fine grain or coarse grain steel as required, but to maintain uniformity in shipment after shipment. Thus tool setups, heat-treating and forging procedures, once established for the steel, require minimum change. Reduced costs and better results follow as a matter of course.

We welcome the chance to show you what U·S·S Controlled Steels can do for you. Invite one of our metallurgists to look over your production line. He will gladly match his time against yours to demonstrate right on your own equipment the money saving possibilities of U·S·S Controlled Steels. It costs nothing to have him call.



Controlled STEELS

USS

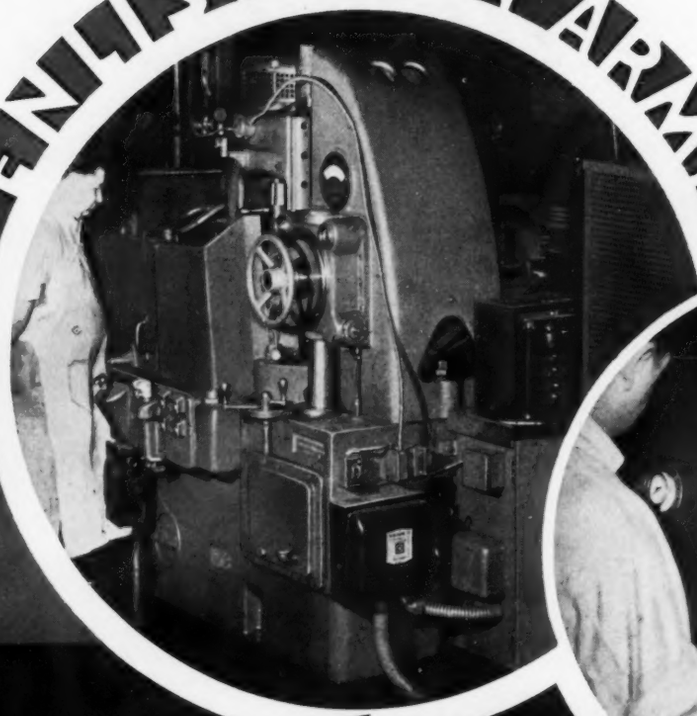
CARNEGIE·ILLINOIS STEEL CORPORATION

Pittsburgh, and Chicago

Columbia Steel Company, San Francisco, *Pacific Coast Distributors*
United States Steel Products Company, New York, *Export Distributors*

STATES STEEL

ENLISTED IN ARMY AND NAVY



Three Blanchard Surface Grinders in the shops of the Brooklyn Navy Yard. Flat surfaces of stainless steel stock for turbine blades are being accurately ground on these machines.

for

long, hard, accurate grinding service

SURFACE grinding by the Blanchard Method is accepted practice in the Springfield Arsenal as well as the Brooklyn Navy Yard.

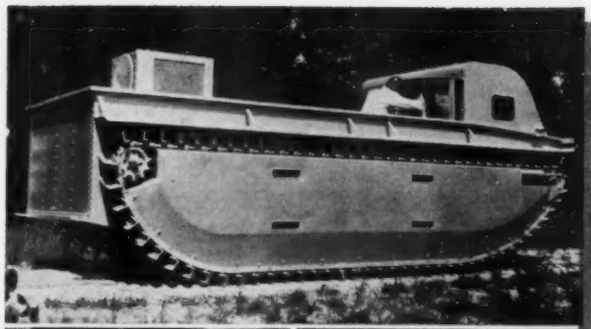
While the nature of work and materials varies widely in these shops, the requirements for precision and finish — such as would be expected in Army or Navy production — are extremely rigid. The selection of Blanchard Surface Grinders by these arms of national defense is significant recognition of the ability of Blanchard machines to maintain accuracy to close limits in long, hard service as well as their versatility in precision finishing a wide variety of flat surface parts quickly and economically.

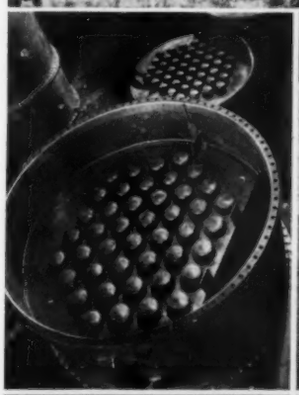
A new No. 18 Blanchard Surface Grinder installed in the small grinding room of the Springfield Arsenal. Another new Blanchard (a No. 10, not shown) is also in this department. Four other Blanchards have been serving the Springfield Arsenal for many years.

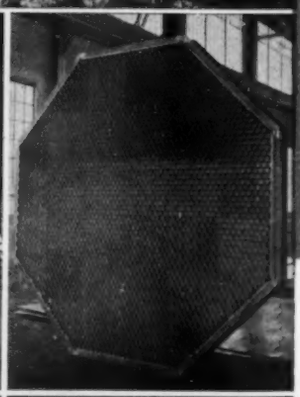
Blanchard engineers are available to assist you find a practical answer to your surface grinding problems.

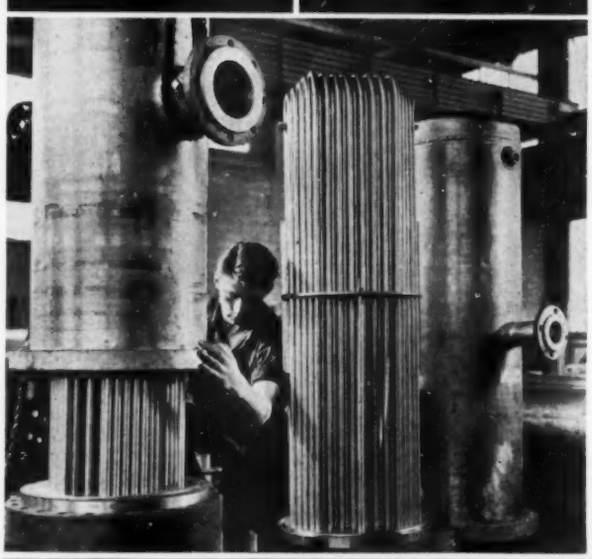
THE BLANCHARD MACHINE COMPANY
64 STATE ST., CAMBRIDGE, MASS., U.S.A.

SEND FOR YOUR FREE COPY OF THE BLANCHARD WORK BOOK









IT CAN BE MADE OF *Aluminum!*

and making things of Aluminum costs less than you think

Aluminum products take many forms, go into every industry. Like the "Alligator" amphibian pictured here, able to run on land or water, they may be the dreams of inventors, materialized. Or, like Aluminum beer barrels, duplicated by the thousands, week after week.

Aluminum can be fabricated by every metal working method. There is an Alcoa Alloy suited to each method, and one which develops these characteristics of Aluminum to best advantage: light weight, resistance to corrosion, strength to suit the application, fine appearance.

Alcoa manufacturing departments represent a wealth of experience in the production of special equipment. They also are available to help you work out practical fabrication problems. Our engineers will advise your men on Aluminum production problems.

How may we serve you? ALUMINUM COMPANY OF AMERICA, 2107 Gulf Building, Pittsburgh, Pennsylvania.

ALCOA · ALUMINUM

Don't laugh

It could be repaired—so could a lot of old machine tools—but...

IT COSTS money to keep fixing old worn out parts. Often without realizing it the entire mechanism has been replaced piece by piece at twice the cost of a new one without any improvement in efficiency. This old "hog" hauled its share of pay loads—and paid for itself many times over. Now its owners have sold it for scrap and ordered a new one to haul the heavier work modern railroads must handle.

Here is a lesson for every shop using machine tools. Before you spend good money keeping obsolete equipment "rolling," investigate the savings that new, efficient tools will make in your production costs. Add to those savings the repair bills for your old equipment and you'll be surprised how quickly they equal the cost of new machines.

In a little while American shops will have to operate at capacity. What that capacity will be depends on the efficiency of machine tools. Obsolete but operatable machines can never compete with new, modern equipment. And it costs as much for the one as for the other.

Let Pratt & Whitney trained experts help you weed out the machines that you can replace *profitably*. These men know modern shop practice. Show them your problems and get their suggestions. There is no better paying investment than the right tools for the job!

Pratt & Whitney

Division Niles-Bement-Pond Co. • HARTFORD, CONN.

FREE HANDBOOKS

Two New Books for Present and Prospective Operators » and Owners of « AUTOMATICS

Each Handbook
Contains Approximately
52 CLEAR ILLUSTRATIONS
33 IMPORTANT TABLES

TYPICAL CHAPTER HEADINGS

Principles of Construction and Operation.
Instructions for Setting Up and Operating.
Standard Tools.
Attachments, Applications, Examples of Work.
Care and Adjustment.
Selecting Cams, Speeds and Feeds.

USE THIS COUPON

Cone Automatic Machine Co., Windsor, Vt.

Please send me the Cone 4-Spindle Hand Book ☐ Please send me the Cone 8-Spindle Hand Book ☐

Name _____ Firm _____

Address _____ City _____ State _____

My Position is _____

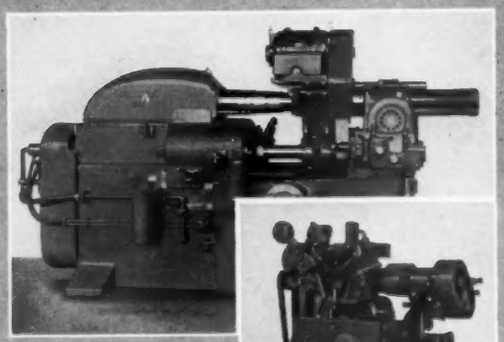
A.M.

HOLE GRINDING IS HANDLED IN THE MODERN LOW COST WAY

at Springfield Armory

ON A BRYANT NO. 16

Convenience and rapidity on precision hole grinding are achieved in the tool room of the Springfield Armory through the use of a modern hydraulically operated Series 16 Bryant Grinder. The illustration shows this machine grinding the inside of a tool steel cutter used in Arsenal production. . . . Accuracy on this machine is assured by an important feature in design — the Bryant overhead wheel suspension. A three-point control for wheel slide provides rigid and accurate control of the wheel spindle. . . . Other exclusive Bryant features of design and construction account not only for their high productivity and accuracy but also for their adaptability to a wide range of work including large or small bores with straight or taper holes. . . . Bryant engineers are at your service to study your hole grinding requirements and offer suggestions for handling your work at lower cost.



(*Above*) No. 24 Bryant Deep Hole Grinder

•

(*Right*) No. 4 Bryant Grinder for small work

BRYANT CHUCKING GRINDER CO.

Springfield, Vermont, U. S. A.

PRECISION . . . PRODUCTION

Precision . . . . . Production, these compelling watchwords of the Aviation Industry are successfully combined today in the new Lees-Bradner heavy type milling machine.

In widely scattered plants, throughout the United States, Lees-Bradner equipment is providing milled threads that exceed the rigid requirements of the aircraft industry.

Lees-Bradner equipment used by Aircraft makers and parts manufacturers.

Thread Millers Gear Grinders
Hobbing Machines
Gear Measuring and Testing Machines

The LEES-BRADNER Company

Manufacturers of Thread Milling Machines, Single Spindle Gear Hobbing Machines, Rotary Hobbing Machines, Gear Grinders and Gear Testers.

CLEVELAND . . . OHIO

English Representatives:
THE CATMUR MACHINE TOOL CORPORATION
LONDON, ENGLAND

French Representatives:
DUFOUR PERE FILS & CIE.
11 RUE NUEVE DE VILLIERS
LEVALLOIS, PERRET, SEINE, FRANCE

Lengthen Service-Life... Increase Ruggedness *and* Cut Manufacturing Costs

WITH BAKELITE MATERIALS

Make your products more enduring, serviceable and economical through the unique combinations of qualities provided in Bakelite materials. The extensive variety of Bakelite plastics now available is helping innumerable concerns to effect substantial product-improvements. Note these examples:

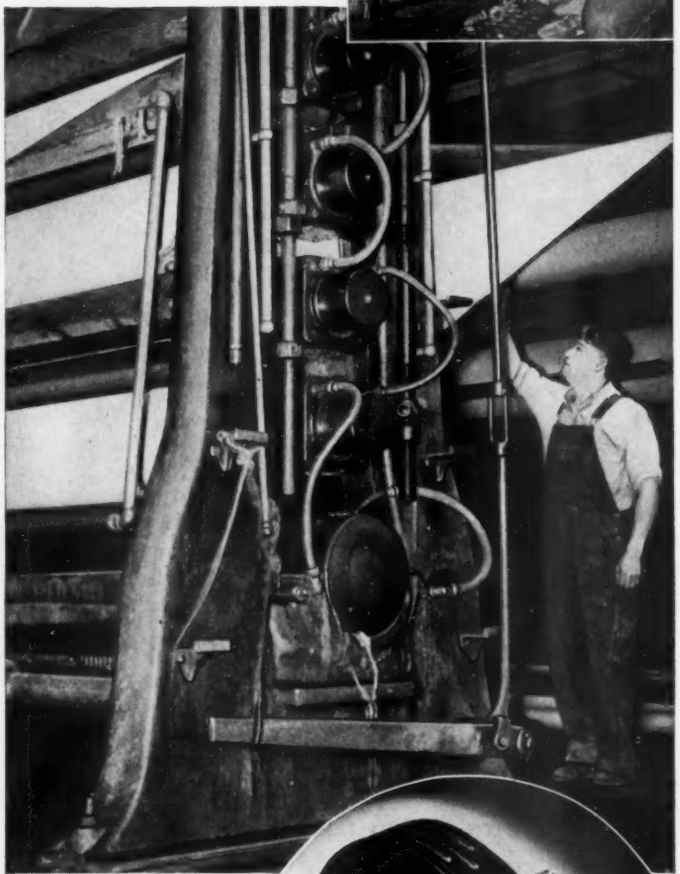
Bearings for paper mill machinery last far longer when made of Bakelite Laminated. Replacing babbitt bearings which "squeezed out" after only five months of service, many of these *water*-lubricated bearings are still in perfect condition after two years—with no maintenance since installation. They have entirely eliminated lubricating time and materials.

Transformer oil containers for Keleket X-Ray apparatus made of impact-resistant Bakelite Molded possess mechanical strength to support heavy transformers, resistance to withstand jars during head-adjustment, and dielectric strength to insulate 90,000 volts safely.

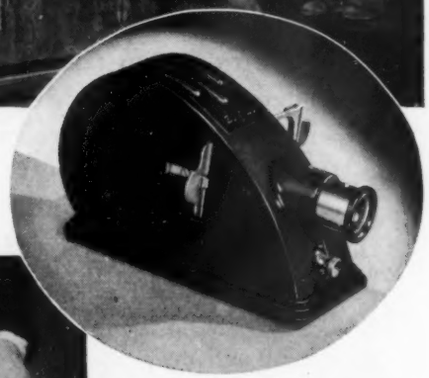
Intricately-shaped Argus Projector housings of Bakelite Molded are easily and economically formed in a single molding operation. They quickly dissipate heat from the enclosed 100-watt bulb.

Among the benefits you can obtain from Bakelite plastics are wide color range, transparent or translucent effects, chemical and dimensional stability, resistance to oil and acids—and many other important advantages. Insure selection of the proper plastics for your specific requirements—consult Bakelite Plastics Headquarters. And write for Portfolio 14 describing many Bakelite materials.

BAKELITE CORPORATION, 247 Park Ave., New York
Chicago: 43 East Ohio Street
BAKELITE CORPORATION OF CANADA, LTD., 163 Dufferin St., Toronto
West Coast: Electrical Specialty Co., Inc., San Francisco, Los Angeles, Seattle



(Above) Water-lubricated paper mill machine bearings of Bakelite Laminated proved by test to be easier and less expensive to lubricate and maintain—and much longer-lasting.



(Above) The Argus Projector housing is less-costly to mold, more attractive, lighter in weight and cooler-in-performance because it is formed of heat-resistant Bakelite Molded. Chicago Molded Products Company, molder.

(Left) The Bakelite Molded transformer oil container of the Keleket X-Ray unit supports the heavy transformer, withstands jars when the head is adjusted and safely tames 90,000 volts. Recto Molded Products, molder.

Consult Bakelite Headquarters for Plastics

More than 2000 plastic materials are available for your selection at this single, central source. There are phenolic, urea, cellulose-acetate and polystyrene plastics . . . materials in all colors, in transparent, translucent or opaque effects . . . special types with high resistance to impact, heat, chemicals or electric stress. Supplied in many forms including:

MOLDING MATERIALS LAMINATED STOCK BONDING RESINOIDS
CAST RESINOIDS SPECIAL CEMENTS BAKING-TYPE FINISHES

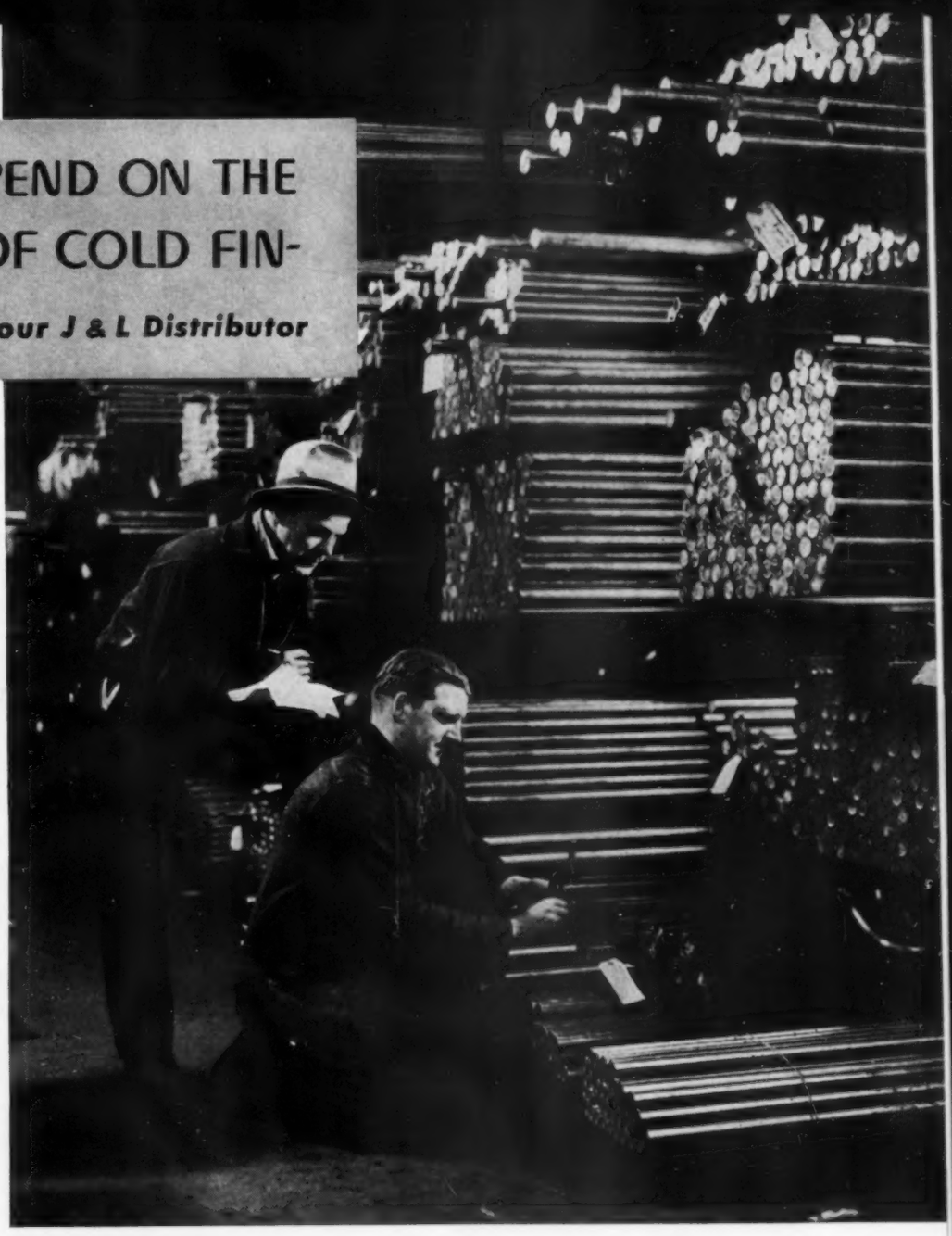
BAKELITE

The registered trade marks shown above distinguish materials manufactured by Bakelite Corporation. Under the symbol "B" is the numbered sign for infinity, an unlimited quantity, to symbolize the infinite number of present and future uses of Bakelite Corporation's products.

PLASTICS HEADQUARTERS

VISIT THE BAKELITE EXHIBIT, HALL OF INDUSTRIAL SCIENCE, NEW YORK WORLD'S FAIR 1939

WHEN PROFITS DEPEND ON THE QUICK DELIVERY OF COLD FINISHED STEEL . . . *Call your J & L Distributor*



When an emergency arises and you need the right kind of cold finished steel in a hurry, remember your J & L distributor has available a complete stock of J & L Controlled Quality Steel exactly suited to your requirements. Like all shipments from the mill, the history and analysis of this steel are known from the time the ore first comes from the mines until it reaches you in its finished stage. It is quality steel — made by the oldest producer of cold finished steel in America. During all stages of manufacture constant vigilance is kept in the control of quality.

When you need steel in a hurry, steel that must process quickly, uniformly and with little waste, don't take chances on ordinary cold finished steel. Order from your J & L distributor. If you don't know his name, look him up in your classified telephone directory. He is listed under "STEEL — Cold Finished." Call him — he will give you quick, intelligent service.

J & L — PILOTS THE COURSE OF CONTROLLED QUALITY IN STEEL

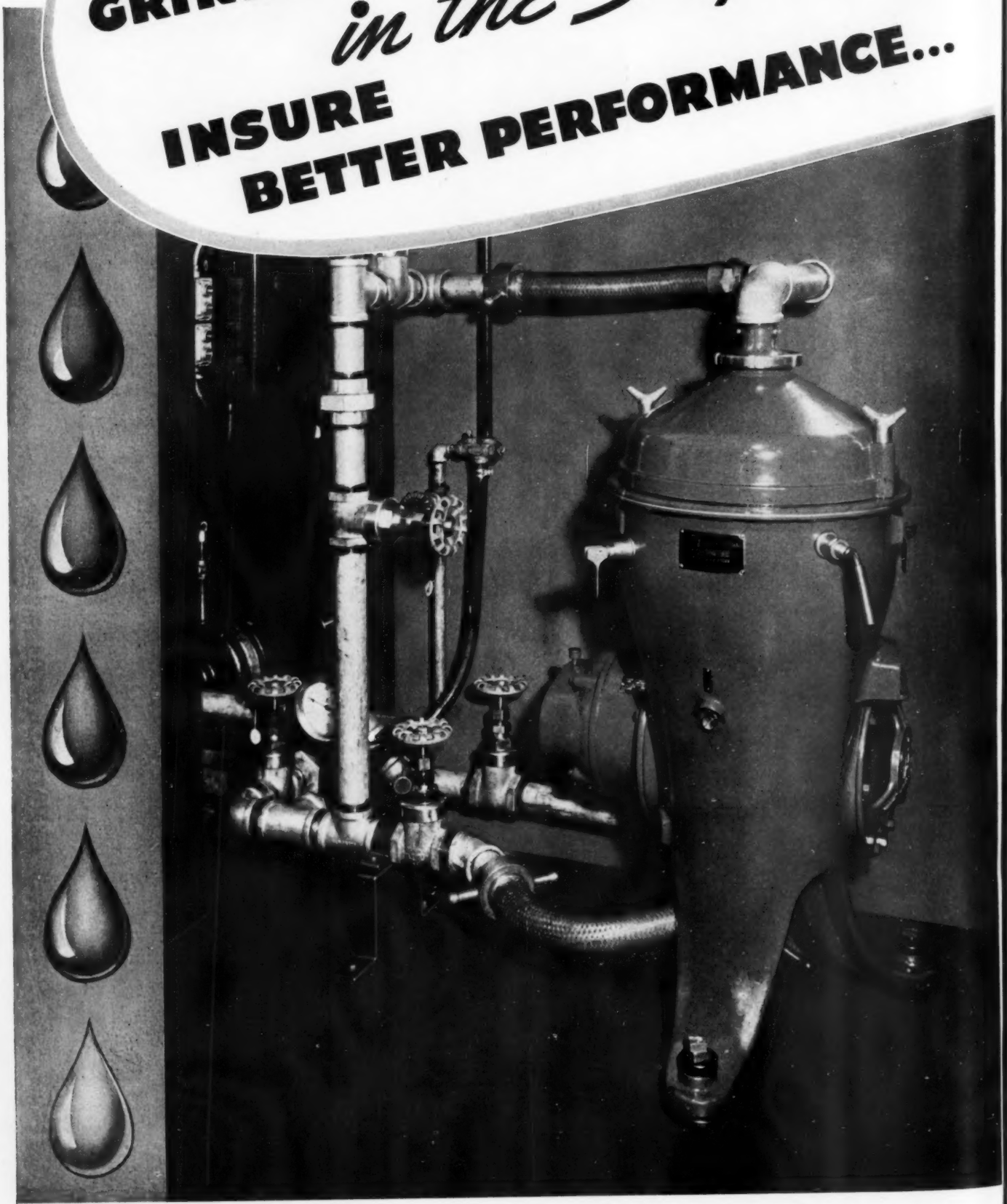
JONES & LAUGHLIN STEEL CORPORATION

AMERICAN IRON AND STEEL WORKS
PITTSBURGH, PENNSYLVANIA

J&L STEEL

J & L — PARTNER IN PROGRESS TO AMERICAN INDUSTRY

CLEANER GRINDING COOLANTS *in the Shop* — INSURE BETTER PERFORMANCE...



...in the Air

... and so this leading airplane engine builder uses the

DE LAVAL Clarification System

to obtain better working surfaces

Precision grinding, such as is required in airplane parts production, calls for clean grinding coolant. Possibly, too, it calls for a more efficient —and more expensive—type of coolant.

The illustration on the opposite page shows how a leading airplane engine builder is meeting both of these specifications: a De Laval "Air-Tight" Coolant Clarifier which employs centrifugal force to continuously remove from the coolant even the tiniest particles of metal and abrasive.

Continuous removal of these impurities avoids scratches on the work, avoids damage to subsurface structure and makes it possible to grind within closer limits. Moreover, it enables the same coolant to be used indefinitely and so makes it economical to employ the kind of coolant best adapted to the work—regardless of cost.

In most grinding operations numerous other economies are effected by the De Laval Coolant Clarification System. Softer wheels can be used; the life of wheels is increased; production is speeded up, and there are fewer rejections.

Write for full information regarding these and other economies effected by De Laval centrifugal machines in modern metal working plants.

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 427 Randolph St., Chicago

•

DE LAVAL PACIFIC CO., 61 Beale St., San Francisco

•

THE DE LAVAL COMPANY, Limited
Montreal Peterborough Winnipeg Vancouver

DE LAVAL
COOLANT CLARIFIERS

Machines Make Jobs AND BETTER JOBS

• The more highly mechanized a plant is, the more it contributes to employment, the lower its unit costs, and the higher the annual wage is apt to be.

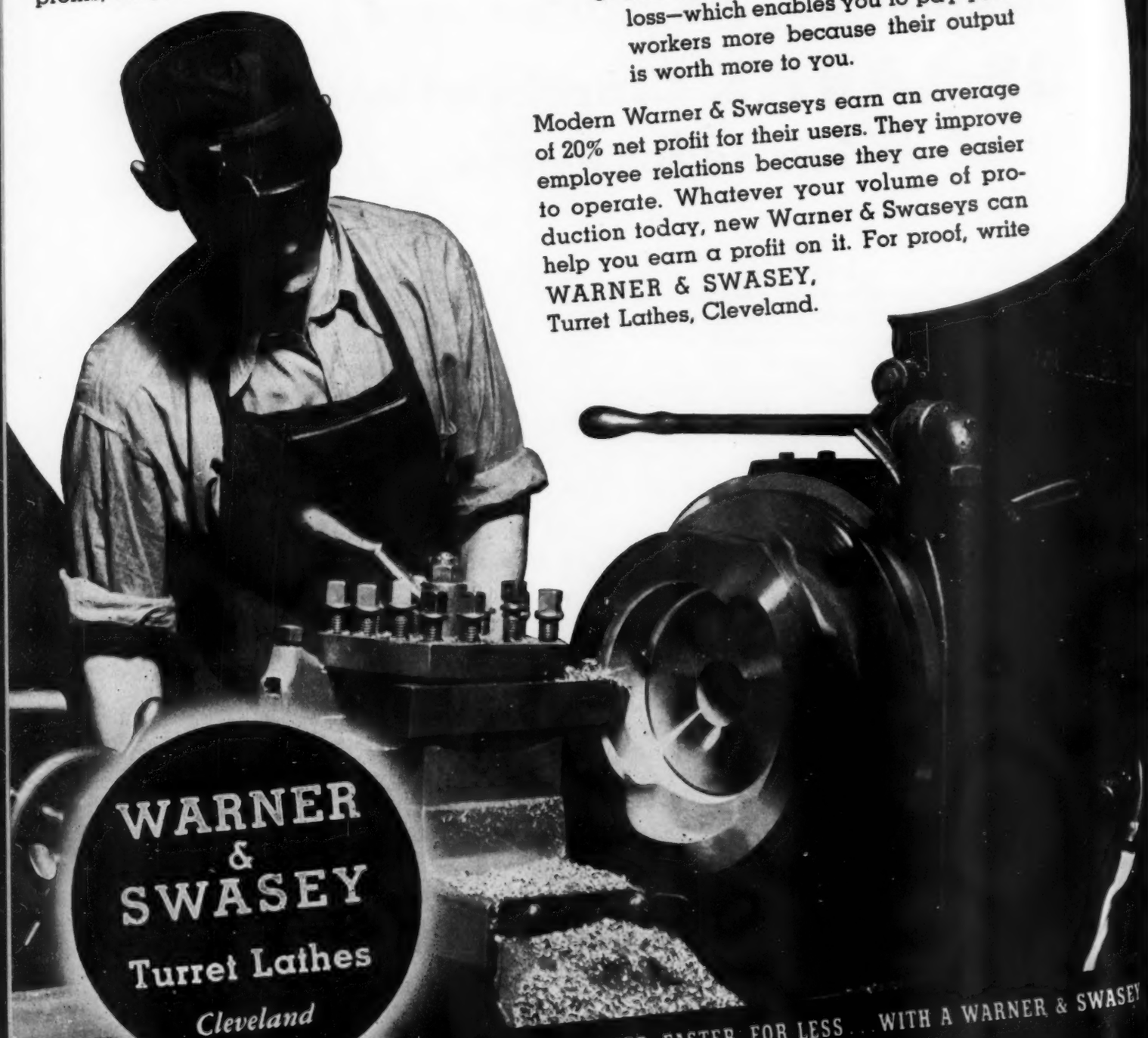
Modern Warner & Swasey Turret Lathes can help *you* improve employment, orders, profits, wages, by—

1—cutting cost per piece as much as 50%—which puts you in better competitive position to get and hold business.

2—improving precision and quality of your product—which again helps you get orders.

3—reducing (often eliminating) scrap loss—which enables you to pay your workers more because their output is worth more to you.

Modern Warner & Swaseys earn an average of 20% net profit for their users. They improve employee relations because they are easier to operate. Whatever your volume of production today, new Warner & Swaseys can help you earn a profit on it. For proof, write WARNER & SWASEY, Turret Lathes, Cleveland.



YOU CAN TURN IT BETTER, FASTER, FOR LESS . . . WITH A WARNER & SWASEY

WHAT'S IN THIS ISSUE

Flexible plant layout is an important feature of Pratt & Whitney Aircraft's factory. Further expansion can take place without disturbing manufacturing methods which are particularly suited to the building of aircraft engines. How this is accomplished is shown on the floor plan and flow chart on page 369. It's worth close study.

Making flying boats is a task requiring highly specialized knowledge, much special equipment and the technique of doing a tailored job in sizable volume. Consolidated Aircraft has mastered this technique, outlined in detail on page 377.

Mobilization of industry in case of a national emergency wouldn't be dragged out over a year or longer as it was back in world war days. Not unless something goes awry with the government's program, and that isn't likely. Industry's part in national defense and how the machinery of mobilization would function are described on page 366.

Turbine drives for naval vessels have long been made by General Electric. How these drives are built for the Navy is told in an article starting on page 397. All sorts of operations are involved—machining, annealing, welding, flame-cutting, testing, to mention only a few. Manufacture is carried on at Schenectady and at Lynn (where the reduction gears are made). Production methods are described not only in the article itself, but in numerous pictures accompanying it.

Welding looms as an important factor in the manufacture of mounts for anti-aircraft guns used by the United States Army. It is only recently however, that welding has been permitted by the Ordnance Department in the production of guns and gun carriages. How York Safe & Lock employs welding in making gun mounts is described on page 405.

Diesel engine manufacture for the Navy involves many production processes at Fairbanks, Morse & Company. Flame cutting and welding, machining of large welded parts, precision work on fuel pumps and other smaller parts are some of the operations which must be performed. They are all outlined on page 387.

Making guns isn't like making any other product. Despite irregular contours, recesses and other odd shapes that multiply machining operations, each component must be fully interchangeable. Replacement parts shipped a year or two after a gun is in service must drop into place and function accurately. That is the manufacturing problem licked by Colt's Patent Firearms Company. The story of this century-old company and how it produces arms for the Army is told on page 397.

G.E. layout for magnetic testing of turbine blades

Machining cartridge cases

Stamping 75-mm. cartridge cases is a job done with high efficiency by the Scovill Manufacturing Company. Cups for 30, 45 and 50 caliber rifle, pistol and machine gun cartridge shells also are in regular production. The technique used by Scovill is described on page 411.

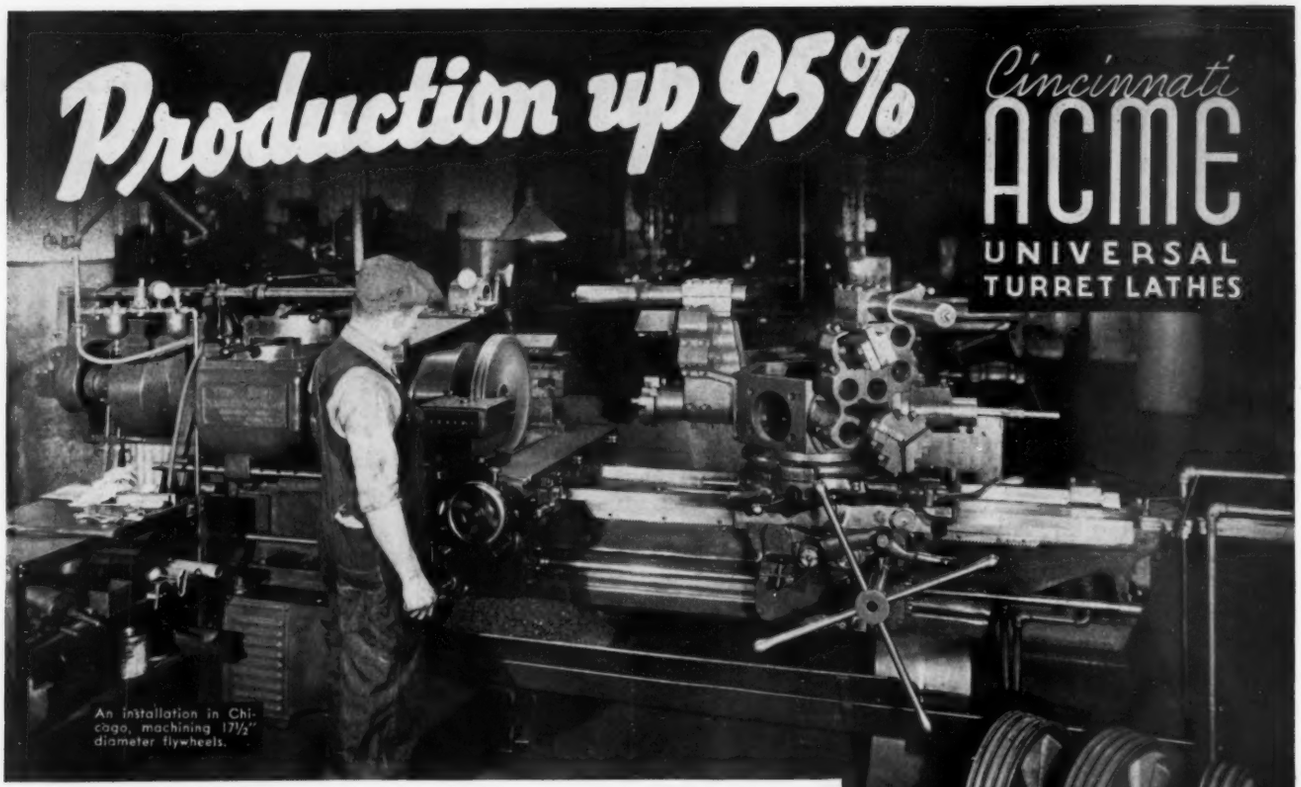
COMING

Gear tooth wear may result from a number of causes. The gear may be incorrectly designed or applied. The workmanship or the material may be defective. The failure may be due to service or operating conditions. The subject is so important that one prominent manufacturer has studied it closely and has reached some important conclusions. These conclusions are of interest to every production man concerned with the causes of gear tooth wear and their correction. They will be summarized in an article, well illustrated, in an early issue.

Artillery ammunition manufacture, which was discussed in Lieutenant-Colonel Campbell's provocative article in the last issue, is of widespread interest. What is being done at the Frankford Arsenal in the production of shell will be further described in the next two issues by Colonel Campbell. This is an authoritative description of methods used in one of the country's few modernized arsenal departments.

Production up 95%

Cincinnati ACME UNIVERSAL TURRET LATHES



An installation in Chicago, machining 17½" diameter flywheels.

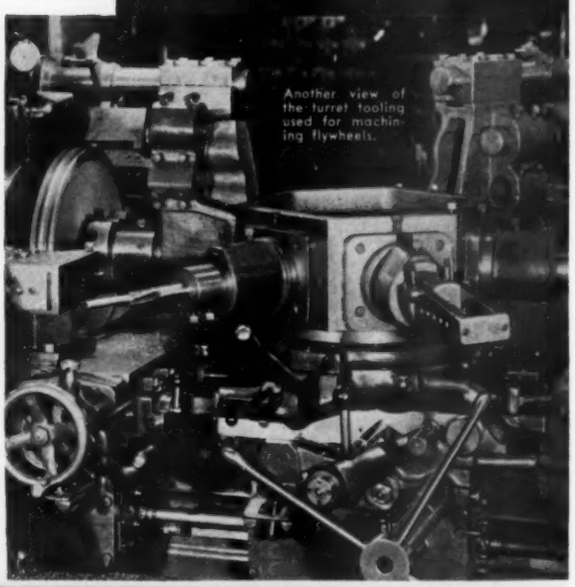
WITH TOLERANCES WELL WITHIN CUSTOMER'S REQUIREMENTS!

● The Cincinnati Acme Universal Turret Lathe illustrated has several innovations in its design, adapting it to the faster and finer machining of flywheels.

A special arrangement makes possible the facing of both back and front sides of the hub simultaneously. Close limits are easily held on both sides by a dual indicator. Air controlled chucking equipment reduces time between pieces.

In comparing this customer's present results against those of their previous method, they are producing 14 to 18 more flywheels per eight-hour day, thereby increasing production approximately 95%! And with tolerances well within customer's requirements!

This sort of outstanding performance can be duplicated in *your* plant. Our Tool Engineers will gladly give you the details of how to increase production and precision . . . decrease cost and waste.



Another view of the turret tooling used for machining flywheels.

THE ACME MACHINE TOOL CO., ... CINCINNATI, OHIO.

ESTABLISHED 1877 **AMERICAN MACHINIST** BURNHAM FINNEY, Editor

Keeping the Peace

NO RIGHT-THINKING PERSON wants war, least of all Americans. Yet only a small number of people, if recent polls are correct, would take issue with the fact that in adequate national defense lies the safety of the United States. Only too recently have we observed the encouragement to aggressors which arises from neglect of one's military establishment.

The United States is a peaceful nation and makes no pretense in normal times of keying its industries to meet military needs. We have no Krupp or Schneider or Vickers or Skoda works turning out munitions on a vast scale year in and year out. Factories doing work exclusively for the government's defense arms are rare.

What would happen in time of a national emergency? Our industries would have to be converted overnight from their normal operations to manufacture of national defense items. To give some conception of what they would be called upon to do, we describe in this issue the production by private companies of products now being made for national defense purposes by seven different firms.

Visualize if you please these operations multiplied by the thousands and you will get some idea of American industry's huge task if mobilization of its vast resources should ever be necessary in a national emergency. Instead of one York Safe & Lock Company building gun mounts, there would be many companies doing the same job. Ten thousand plants or more would be enlisted, along with millions of men, for the duration of the emergency.

Upon the ability of those thousands of plants to produce the government's requirements, just as much as upon the tactical efficiency of our Army and Navy, would depend the outcome. If a potential enemy, in fact, were aware of our industrial as well as our military preparedness, he would think a long time before precipitating a clash. It was the lack of such industrial preparedness on our part, so the story goes, that led the Kaiser to declare unrestricted submarine warfare back in 1917. His Army high command had reported American industry to be hopelessly unprepared.

How tragic it would be for us to invite aggression again because the world knew that it would take us a year or longer to get going! What country, on the other hand, could rival us, in men and materials, if our industries were trained for an emergency and had adequate modern equipment at hand for the job?

Our objective in this issue is to bring to the attention of metal-working companies their tasks in case of a national emergency. A study of the contents will help orient the thoughts of executives to the job of national preparedness which lies ahead. Better be prepared for trouble in case it might come than sorry afterwards.

Brigadier-General C. T. Harris, Jr., says, "The Army is as dependent upon industry as it is upon its soldiers." A prepared industry may well be the deciding factor in keeping us out of a war.

Industry's Part in

THE UNITED STATES will not go into another war at sixes and sevens regarding the job which its industries should do. Back in 1917 there were months on end of delays. Nobody seemed to know what it was all about until a year or more after war was declared. But that won't happen again.

Industry's part in national defense is clearly defined. And that is a good thing, because the least of the government's worries in a national emergency would be man power. The greatest worry would be prompt and continuous procurement of supplies.

Military authorities, because it is their job to do so, are constantly striving for perfection in their plans to meet the problems arising in an emergency. Industrial participation on a vast scale is an indispensable part of that plan. The plan has never been subjected to an actual test (and we hope never will be, because Americans have a natural revulsion toward war). But in educating industry to an understanding of its tasks in connection with national defense, it already is proving itself valuable.

What is that plan which, because it is known to other countries, may in itself be a deterrent to war? It dates back to 1933 when the War Department's mobilization plan was put through. After experience with this plan, a revised plan (the protective mobilization plan) was adopted in 1938.

It calls for mobilization of 1,000,000 men as a starter. More than that number would be under arms in four months. Over 10,000 industrial plants have been surveyed and allocated schedules of war items which they would be asked to produce. As nearly as possible, the war products would resemble those made in peacetime. In that way the transformation of a factory from normal operations onto a war basis could be accomplished with the least disruption and in the shortest time.

Here is the way the plan works. The ordnance department of the United States Army, the business of which is to keep the Army and Navy supplied with necessary war materials, has divided the country into fourteen procurement districts. In addition, there are six engineering corps districts throughout the country. Before any assignments are made of plant capacities and their adaptability to manufacture of certain ordnance items, the entire situation is closely studied.

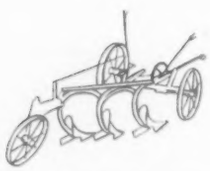
After officers have made searching surveys of individual factories, and the management of a company has agreed to cooperate, the company is asked to sign a so-called "schedule of production" which it would be expected to produce in case of war. This "schedule" has no standing as a legal document, but constitutes a pledge of performance and gives the arrangement an official status.

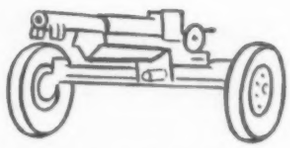
Except in rare cases no attempt is made to allocate the entire capacity

WARTIME ASSIGNMENTS

THE WAR DEPARTMENT has carefully surveyed U. S. production facilities and tentatively assigned each major plant a war product that it is equipped to turn out. Each item in the list following represents an actual manufacturing unit, its peacetime product and its wartime assignment. These are a typical few of many "facility conversions."

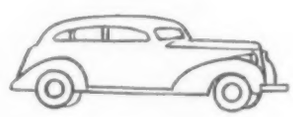
NORMAL PRODUCT	WAR PRODUCT
Automobile Bodies	Airplane Parts
Electric Refrigerators	Airplane Parts
Boats and Lighters	Pontoon Bridges
Wheelbarrows and Road Scrapers	Ammunition Carts for Machine Guns
Agricultural Implements	Combat Wagons and Gun Carriages





Commercial Steel Castings	Tripods for Anti-aircraft Guns
Rolled Steel Products	3 in. Anti-aircraft Gun Forgings
Fire Sprinklers and Alarms	Artillery ammunition components

NORMAL PRODUCT	WAR PRODUCT
Electric Elevators	Recoil Mechanisms for 3 in. A.A. Guns
Printing Presses	Gun—Howitzer parts Recoil Mechanisms for 155-mm. Howitzer
Automobiles	Cartridge Cases, 75 mm.



Automobile Engines and Motor Cars	Airplane-type Combat Tank Engines
Fabricated Piping and Air Conditioning Equipment	Bomb Bodies
Electric Welded Pipe	Demolition Bombs and Torpedo Parts
Pipe Fittings and Valves	Hand Grenades
Watches	Mechanical Time Fuzes
Electric Equipment	Cartridge Cases, 10-mm. Howitzer
Cash Registers and Business Machines	Bomb Fuzes
Postal Meters	Bomb Mechanisms
Radio—Phonographs	Bomb Fuzes and Parts

National Defense

of a factory to war goods. This makes it much easier for the management to put production back onto a normal basis when war ends.

Improvements in the program have been made recently. A real effort has been exerted to relate the allocated war items more closely to the products now being built by companies. The desire is to eliminate bottlenecks which might clog the output of essential items in time of war.

Most serious bottleneck occurs in a series of some 54 critical items which normally are not made by private industry (such as gas masks, anti-aircraft gun mounts, M-1 rifles). The War Department is acquainting as many firms as possible with manufacture of these critical items by means of "educational orders."

These orders are placed for a limited quantity of certain items. When a company receives an order, it sets up a production line to make the specified product, building the essential tools, dies, jigs and fixtures. It is estimated roughly that about 30 per cent of the amount of the contract will be spent for the tooling process, including machine tools and other machinery.

The result of the educational orders program is that a group of companies becomes familiar with the technique of making materials vital to the success of a military force in wartime. If war broke out, months of valuable time would not be wasted in mastering this technique, starting "from scratch." The War Department has recently awarded approximately $2,000,000 of educational orders. Another $32,500,000 is certain of allotment in connection with the 1940 military appropriations bill.

While the War Department knows all the family secrets of companies which will be called on for service in wartime, these companies are acquainted with the items assigned them by means of drawings, specifications and other descriptions furnished by the government. By a Congressional Act of July 27, 1937, the War Department was authorized to sell, loan or give to these companies samples of supplies or equipment to be made.

Holding a key position in the mobilization plan is the Army and Navy Munitions Board. In fact, it heads up industrial mobilization as a peacetime activity and would continue to supervise it after the outbreak of war until possibly a super-agency superseded it. The industrial mobilization plan of 1936 was worked out by this board. The board also has succeeded in bringing the Army and Navy into agreement in allocating productive capacities in vital industries where the needs of both branches of the service overlap.

Provision is made in the industrial mobilization plan for a war resources administration created by the President in case of war. This super-agency would be civilian manned and operated. Between it and the War and Navy Departments the Army

OF PEACETIME PLANTS

NORMAL PRODUCT	WAR PRODUCT
Automobiles	Artillery Projectiles—Shell
Fabricated Basic Steel Products	Armor Piercing Projectiles
Pullman Cars	Forgings for 105-mm. Howitzer
Railroad Cars	Artillery Shell Forgings
Steel Products	Forgings, 75-mm. H.E. Shell
Buses and Trolleys	Machining, 75-mm. H.E. Shell
Pumps and Wood Working Machinery	Machining, Artillery Shell
Plumbing and Sanitary Fixtures	Machining, Artillery Shell
Linoleum and Floor Coverings	Machining, 75-mm. Artillery Shell
Lawn Mowers	Machining, Shrapnel
Railway Signals	Machining, Artillery Shell
Automobile Steering Gears	Machines Guns
Drop Forgings	Machining, Artillery Shell
Business Machines and Appliances	Artillery Shell
Agricultural Implements	Artillery Shell

NORMAL PRODUCT	WAR PRODUCT
Rail and Wire Products	Artillery Shell
Railroad Locomotives	Machinery 155-mm. Shell
Oil Well and Drillers Supplies	Machinery 155-mm. Shell
Adding Machines	Automatic Pistols
Matches	Aircraft Cartridge Signals
Rolled Copper Plate	Metal Components for Ammunition
Steel-Lead Containers	Ammunition Adapters and Boosters
Automatic Lead Pencils	Ammunition Components
Precision Instruments	Navigation Compasses
Motor Cooling Equipment	Airplane Landing Wheels
Springs and Metal Stampings	Gas Mask Parts
Office Furniture	Bomb Containers
Vacuum Cleaners	Gas Mask Parts
Cans and Food Containers	Gas Mask Canisters
Mining Machinery	Light Combat Tanks
Motor Cars	Light Combat Tanks

and Navy Munitions Board would act as a liaison agency. Other super-agencies are provided for the control of finance, trade and other elements. This part of the industrial mobilization plan, however, has never been authorized by Congress. Considerable opposition to it exists in industry.

It is easy to see from the foregoing account that the government has been alert in taking the necessary steps to avoid the impasse which stalled our war machine for more than a year after the United States declared war in 1917. The government has Army arsenals and Navy yards, but the fighting forces are dependent upon private industry in wartime for over 90 per cent of their requirements.

As the United States expands its military and naval establishments as national defense measures, the amount of work to be done by American industry for the Army and Navy will grow. The volume now is much larger than it was even a year ago. It probably will be still bigger a year hence. Consequently, the role of private industry in national defense is taking on increasing importance as the days roll by. Since American industry leads the world in manufacturing technique and its resources are unrivaled by other countries, the building of an effective national defense program appears to be in good hands.

INDUSTRY'S PART VITAL

By BRIGADIER GENERAL C. T. HARRIS, Jr.
Assistant to the Chief of Ordnance, War Department

MODERN ARMIES can be trained much faster than they can be properly equipped. The task of equipping armed forces is vastly greater today than it used to be because the manufacture of war material is more complicated. It calls for a highly specialized knowledge on the part of the maker. The larger the number of manufacturers who have such specialized knowledge, the stronger is our national defense. This is the reason why industry's part in national defense is more vital than ever before.

LINKED TO THE NAVY

By REAR-ADMIRAL HAROLD G. BOWEN
Chief, Bureau of Engineering, U. S. Navy

THE NAVY looks to private industry as a key factor in successful completion of the expansion program now under way and in meeting any national emergency which might arise. Half or more of the ships to be constructed for the Fleet are to be built in shipyards of private companies. Most of the equipment, machinery, parts and materials for all the ships, including those built by the government, will be supplied by industry. So American industry and the Navy are inseparably linked.

Engines for the Air Force

Pratt & Whitney Aircraft laid out its plant with an eye to the rapid growth in demand and development of the aviation industry

EVER SINCE its founding, Pratt & Whitney Aircraft has been closely identified with the development of airplane engines for military use. In 1925, the year the company was formed, the U. S. Navy had reached the conclusion that to be effective, its aircraft must be based on the fleet instead of on shore; to reach this objective it was found necessary to use more powerful engines than were then available.

Pratt & Whitney founders undertook to fill this need with a new 400-hp. air-cooled radial engine. The success of this design was the start of an enterprise that has since been of outstanding service in the development of military and commercial aviation. Today, Pratt & Whitney Aircraft builds radial air-cooled engines up to 1400 hp., and the limits of this type of power plant have not yet been reached.

Army orders as well as Navy orders tended to speed the rate of development; because of tactical advantages international competition in aircraft advancement is necessarily keen. By the middle of 1938, 14,000 Pratt & Whitney engines had been produced.

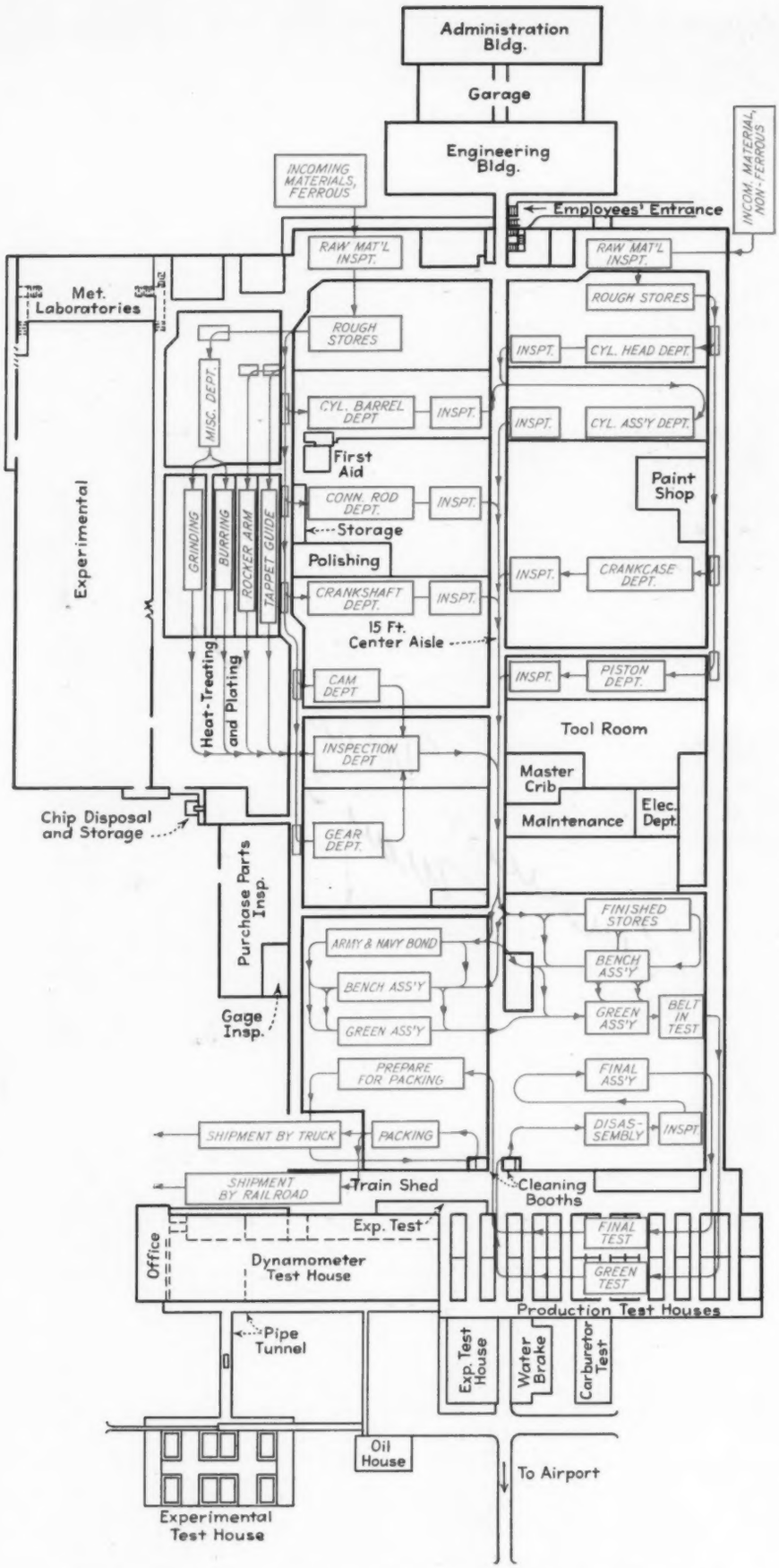
Back in World War days, some $640,000,000 was spent in trying to create an American aircraft industry. The Liberty motor was designed and farmed out for manufacture to concerns with little or no previous experience in this particular work. As a result valuable months went by without planes; however, production was well started when the armistice ended the war.

Today we would face the situation in entirely different fashion. We have plants, such as Pratt & Whitney Aircraft, whose daily work is in this field. They have already acquired the "know-how" that is so vital in any industry where exacting requirements must be met.

In 1929, the engine company, until then housed in a section of the plant of the Pratt & Whitney Division of the Niles-Bement-Pond Company, joined with other aircraft firms to form what is now known as the United Aircraft Corporation. The corporation consists of three manufacturing divisions: Pratt & Whitney Aircraft, Hamilton Standard Propellers and Vought-Sikorsky Aircraft. The present location in East Hartford was selected in 1929, and construction was started on buildings which now house the first two of these divisions. Vought-Sikorsky is located at Stratford, Conn., on Long Island Sound, where its seaplanes, amphibians and flying boats can be conveniently tested.

A good reason for the New England plant locations was the availability of skilled, competent mechanics. The Yankee craftsmanship which has in the past done so much for the nation's mechanical development is still very much in evidence, and it is a highly desirable asset in aircraft manufacture.

Pratt & Whitney Aircraft is a flexible plant designed for a flexible product. It can be said that practically everything has doubled in aircraft during the past fifteen years. Speed, power and the size of the ships themselves have all increased twofold in this short span of years. In an industry where things move fast, production facilities must be set up so they can keep pace; else they soon become antiquated and useless. Pratt & Whitney's ability to keep pace has not depended entirely on the fact that its



Straight-line production is used in the Pratt & Whitney Aircraft plant. Expansion is possible without disturbing manufacturing methods

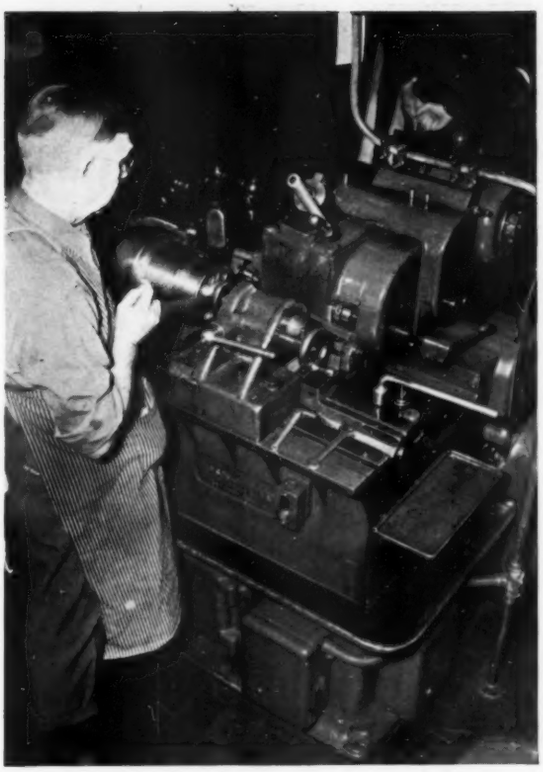
managers have been good opportunists, clever at devising ways to convert a small plant into a larger one. It is largely a result of the fact that the original plan of manufacture was laid out on a basis that could be maintained as the industry grew and the product changed.

The Pratt & Whitney Aircraft plant has successfully met three major changes in its manufacturing requirements which have fully justified the foresight of those who planned the original buildings and the successive stages of development. First, there was the addition of the two-row radial engine which meant fourteen cylinders instead of nine with all the extra connecting rods, pistons and other parts that went with them. Again in 1936, when both the engine plant and the Hamilton Standard Propellers division required more space, a new building was added adjacent to and connecting with the engine plant. In this building, propeller operations were segregated. At the same time, the plan of expansion gave flexibility for a further move which has just now been completed.

Because of still further demands on the engine and propeller divisions, the former Chance Vought Aircraft division has been moved to Stratford and consolidated with the former Sikorsky Aircraft division to which 10,000 sq. ft. of floor area has been added; the Hamilton Standard Propellers division has been transferred to the original Chance Vought plant, and the engine division now occupies the additional building originally built for propeller operations as well as its own former housing facilities. A third floor has been added to the two-story Pratt & Whitney engineering building with a floor area of approximately 14,250 sq. ft.

A study of the accompanying floor plan and flow chart will show how these things have been accomplished and how, if need be, further expansion can take place without disturbing manufacturing methods which have been found to be particularly well suited to this product. Straight-line production is used here, but not in the sense that the automobile industry has adopted. The high degree of accuracy in all aircraft engine parts and the soft metals used for many of them does not make the use of material handling by conveyor advisable.

Another consideration is the fact that aircraft engines are not made for stock, but instead are tailored to meet customer specifications. For example, if spare part requirements are included, there are some 50 different

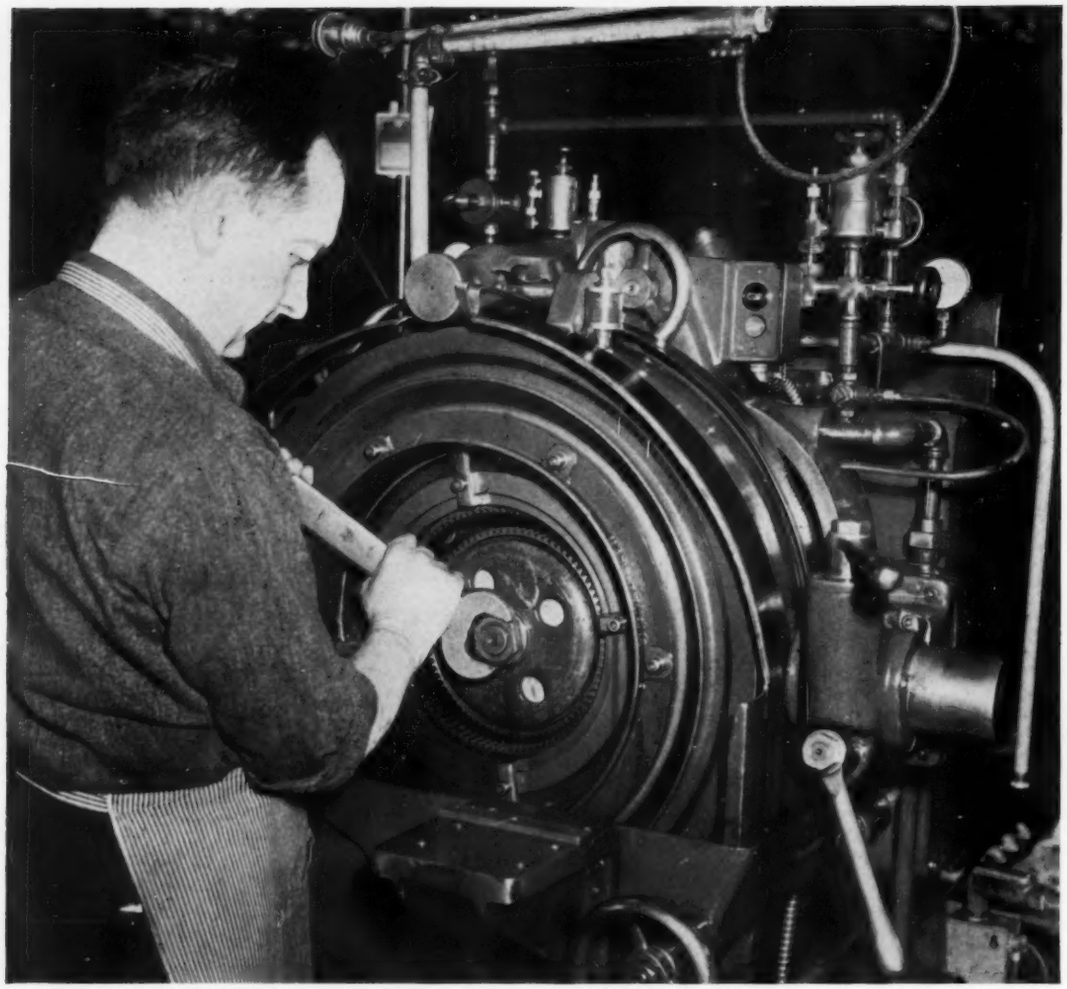


The operation of thread milling the cylinder barrels is done on the same arbor on which the outside diameter has been ground

Master connecting rods are honed in a machine made by the Barnes Drill Company. The operation shown is on the crankshaft bearing. A smaller machine hones the circle of smaller holes to which the link rods are assembled

Another thread grinding operation is on the crankshaft. This work is performed in an Ex-Cell-O machine

Link rods are diamond-bored, both ends at one time. Although there is a 0.001-in. limit on the bores, shop practice is to hold them within 0.0002 in. on the high side. Subsequent polishing operations have a tendency to close the holes slightly. A Coulter double-spindle machine is used



The valve cam gear is lapped in a Fellows machine by means of an internal tooth lap. The gear is rotated for four minutes in each direction to remove about 0.0002 in. of metal

types of complete cylinder-heads. This diversity means that the airplane engine industry is not on a mass production basis in the sense of automobile manufacture and cannot be rigidly bound by a mechanical set-up that would interfere with its flexibility.

It will be noted from the floor plan that the administration and engineering buildings are separate although connected with the factory proper by passage ways. Either building can be expanded vertically or horizontally without disturbing the rest of the plant. A mezzanine at the end of the manufacturing plant contains the shop offices and includes provision for Army and Navy inspectors.

The manufacturing space, all on a single floor level, is 400 ft. wide and 1,000 ft. long. It has a main center aisle which divides the machining departments in two. One side of the aisle is devoted to departments working on non-ferrous parts, while the other side contains all operations on steel parts. This arrangement makes

Pistons are drilled for their pin holes in a double-end Taft-Peirce special machine. This equipment takes the place of two previous operations when the holes were drilled in a radial drilling machine and then had to be semi-finish bored. Correct alignment is assured by the new method

it easy to keep the cutting oils separate and to segregate the chips from these two major groups of machines.

In general, the floor space is divided into manufacturing departments, each of which is devoted to a major engine component. Foremen and workman become accustomed to handling a certain kind of work, and their responsibility for its quality is undivided.

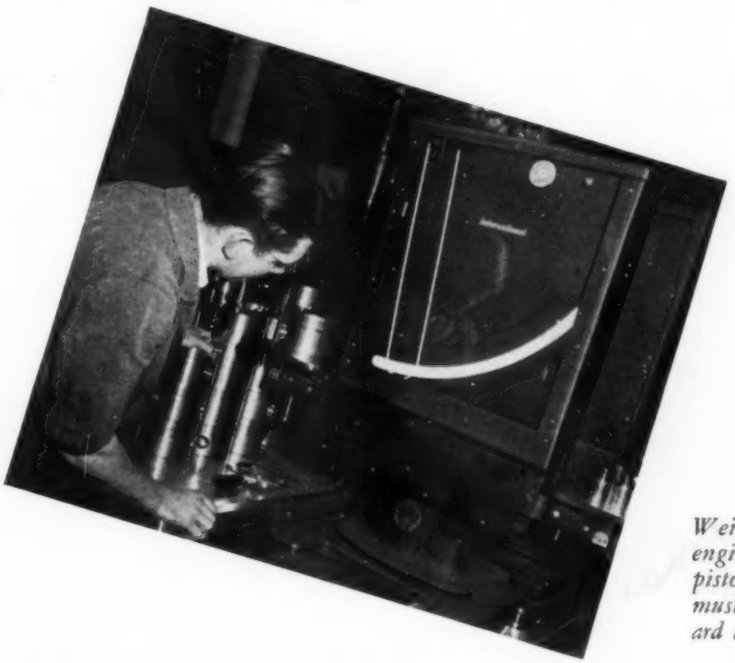
Operations within a department are arranged so that the final machining and inspection is done adjacent to the center aisle. From here the work is handled on electric trucks which take it to the Pratt & Whitney finished stores, or the Army and Navy bond sections, until it is required for assembly.

Thus the material handling problem is solved by eliminating as much of it as possible.

It can readily be seen that side walls of the plant mean little in an arrangement such as this. If these walls are moved back to give more floor space, each department is expanded proportionately without interfering with its neighbor. Pratt & Whitney Aircraft's production facilities can be further increased several fold without disturbing its basic method of manufacture.

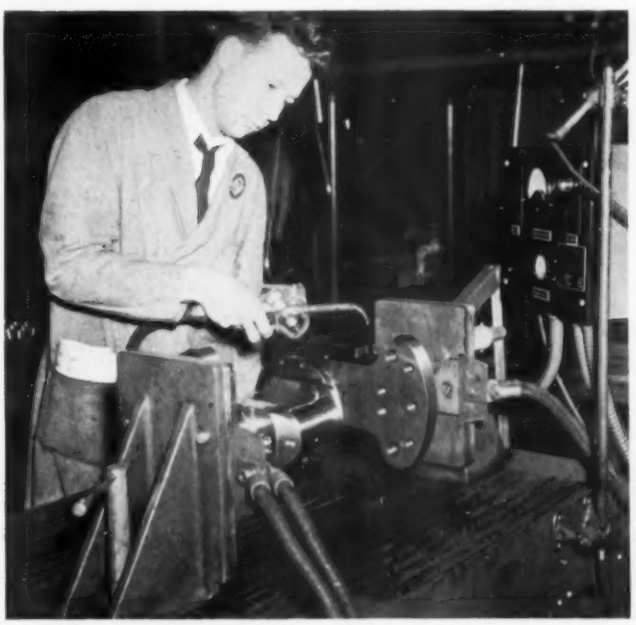
Close limits are inherent in airplane engine design. This is to be expected since precision means dependability. Aircraft parts must fit correctly in order to function tirelessly. For this reason, many of the manufacturing operations are designed to maintain tolerances down to a ten thousandth of an inch. Such tolerances are not unknown in other industrial plants; but in no industry are they used with such profusion as in aircraft engine manufacture. In the making of many types of machine parts, there is one controlling dimension that receives particular care, but in an aircraft-engine part there may be a dozen or more such exacting dimensions.

In addition, special attention must be given to the materials themselves and to surface finish. Pratt & Whitney makes no forgings or castings itself, but has developed outside sources of supply and purchases these parts from specialists. Finished parts



Weight is all-important in aircraft engine parts. In this illustration the pistons are being weighed and they must come within 0.01 lb. of standard to pass inspection

Gear contours are made smooth and accurate in a Pratt & Whitney double-wheel gear grinding machine. The machine can grind the working surfaces of a gear tooth in one pass



A Magnaflux test is given the crankshaft for a Twin Wasp engine. This shows the new continuous flow process in which the flux-bearing solution is applied while the work is in the magnetic field. Invisible flaws are shown up by this test

of many kinds are obtained from outside sources.

Whether the parts are acquired from outside or made in the Pratt & Whitney plant, they are subject to a rigid inspection. All completed parts that come into the plant are sent to a special inspection department where they are carefully gone over by trained inspectors before being passed. For instance, the exhaust valves are purchased outside. These contain a certain quantity of metallic sodium which liquifies under heat and affords an efficient conducting medium to keep the valve head cool. An inspection device has been set up for determining the quantity of sodium in each valve stem. The device depends simply on the difference in electrical resistance between the sodium filled portion and the hollow stem. Similar methods are applied to other parts.

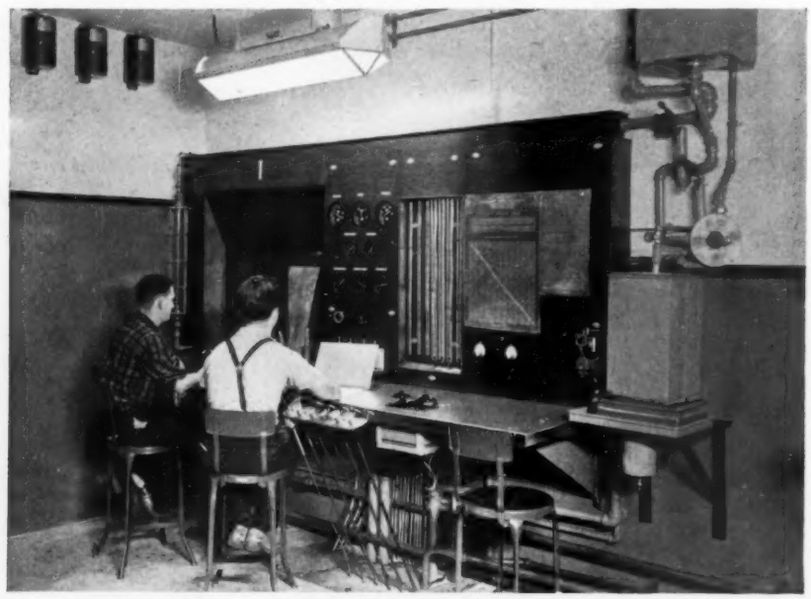
Where part contours are important, they are magnified and compared with standard requirements by visual comparators. In certain forgings, grain flow is highly important. In the connecting rod for example, it is desirable that the lines of flow not be cut by machining operations that determine the outside finish of the forging in the highly stressed sections. This flow is determined by deep etching and microscopic examination in accordance with approved metallurgical practice. Naturally, hardness tests are widely used; all forgings are checked for their Brinell readings.

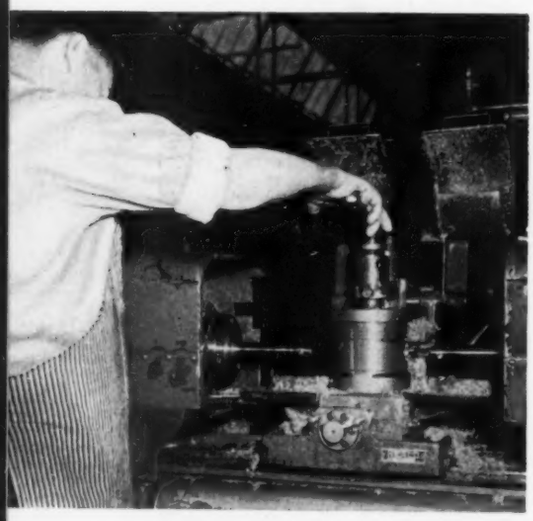
Many of the machining operations in the Pratt & Whitney plant are devoted to the accurate finishing and sizing of the engine parts. The cylinder barrels are threaded to fit them to the cylinder heads. Although this is a shrink fit it is essential that it be tight, and for this reason extreme care is taken to insure a very smooth thread.

Connecting rods are machined all over. This is to control their weight and also to eliminate any sharp edges or corners that may have irregularities in the form of roughness or scratches that might be the source of a crack in the part. The main connecting rod is honed after it is through the other operations to give it a mirror finish—not only in the main holes for the crankshaft, but also in the holes used for assembly of the link rods. Gears are ground after cutting in order to produce true involute contours and to obtain surfaces free from any trace of roughness. Certain of the gears are machine lapped for their final finish.

Work in process is under continuous scrutiny in order that the high standards of quality may be preserved. Each machine is equipped with its own check gages so the operator can continually inspect its output and make corrections if any deviation from specifications shows up. Along the aisle at the end of each machining department there is a bench at which Pratt & Whitney inspectors give each part a careful go-

A Heald double-spindle Borematic machine diamond bores the pin holes, first with a carbide tipped tool and then with a diamond tool which produces a hole of mirror smoothness and within 0.0002 in. accuracy





Test engineers in the observation room of the Power Palace are enabled to make exhaustive readings concerning all phases of engine performance

Valve cam contours are ground in a Norton machine with a special master cam for guiding the grinding wheel to the correct contour. This piece has to be ground twice, once for the exhaust cam and once for the intake cam

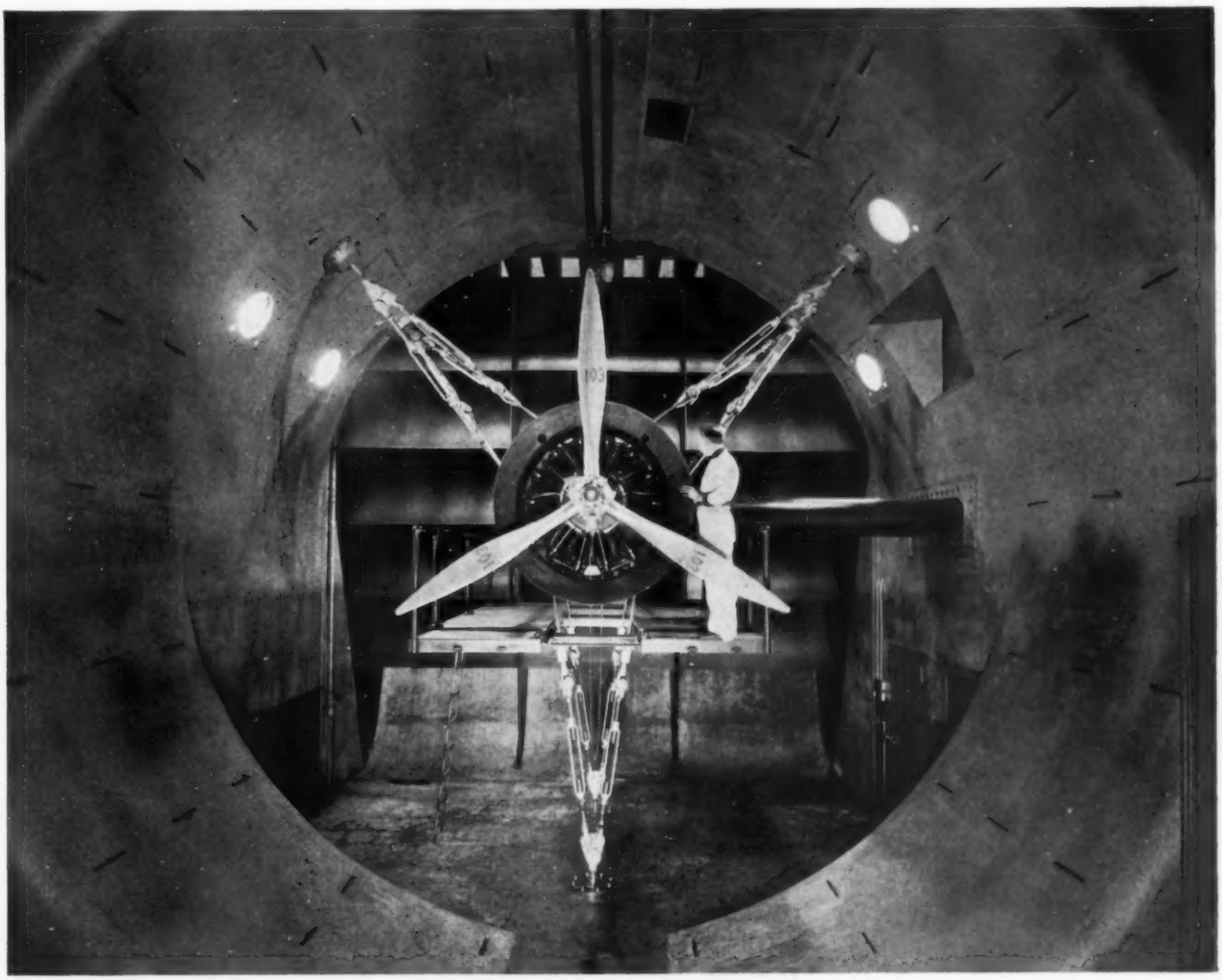
ing over. When these parts are assigned to Army or Navy engines, they pass on to a second bench at which government inspectors repeat the check-up to their own satisfaction. Army and Navy parts are segregated in a special bonded storage department while they are awaiting assembly.

Magnaflux inspection is used on many of the parts. The crankshaft is an example of a part that undergoes this process. The part is magnetized and covered with a finely divided magnetic material either dry or in solution. Any flaw or crack that interrupts the lines of magnetic force is quickly shown up by the segregation of these particles at such points. Pratt & Whitney Aircraft has one of the latest continuous flow Magnaflux machines in which the magnetic particles are sprayed on while the part is held between electromagnets. In other cases, the parts are magnetized and then dipped into solutions containing magnetic iron oxide.

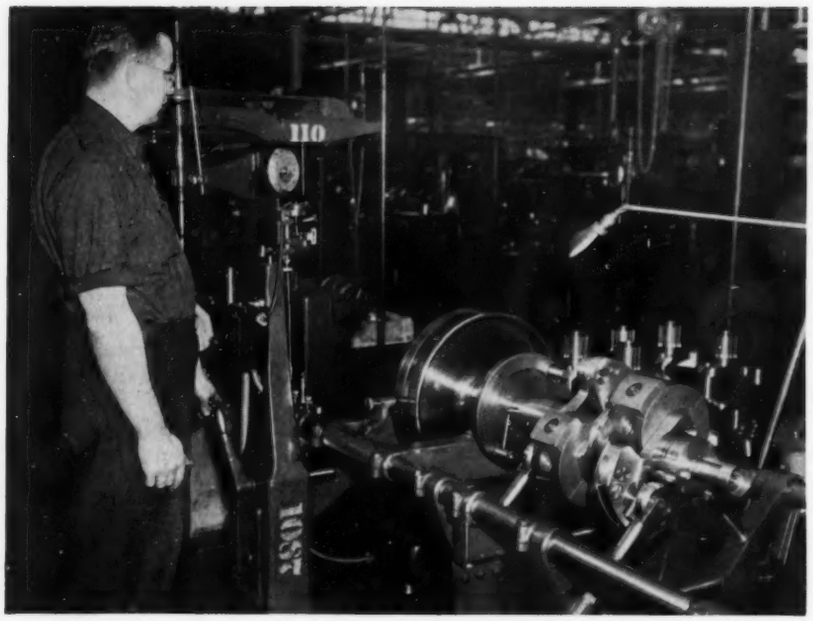
Engines are assembled on portable stands which move transversely across the shop. These stands are specially designed, so the engine carrying section may be revolved through 180 deg. and the work can be expedited by using the correct angle. Sub-assemblies are built up on benches placed at right angles to the main assembly line. These sub-assemblies are so located that they will feed into the main unit at the proper point along the assembly. The assembly stands are mounted on rollers and progress along the line by being moved by hand.

This line is called the "green" assembly line because it represents the first assembly of the engine. After all the steps in assembly have been completed and the engine is oiled, it is put through a "belt" test. In reality no belt is used, but the engine is connected by means of a coupling to an electric motor with a built-in reduction gear and is run for one hour at 300 r.p.m. This step makes certain that all parts move freely and that the lubricant is pumped to all sections of the engine at correct pressure. The belt test is followed by the "green" test which lasts for ten hours. The test is conducted in fully inclosed booths with a window in one side so the engine operation can be observed. A record is taken of the engine performance including oil consumption, fuel consumption, cylinder temperature, oil temperature and power output. Any mal-functioning is observed as indicated by loss of power or speed, or excessive fuel or oil consumption.

Engines are first run for four hours at 1,000 r.p.m. During the fifth hour they are stepped up from this speed to 90 per cent of the full rated speed at which they are operated for two hours more. They are then run for an hour and a half at 90 per cent of the rated power which is considerably above 90 per cent of the rated speed. Next they are run for a half hour at full power which includes a



An interior view of the Power Palace shows the method of mounting an engine during tests. The observation window may be seen at the upper right with the duct for the fuel oil and exhaust lines directly below it



Another requirement of an airplane engine is good balance. Here is shown one of the two-row Wasp crankshafts being checked up in a Gisholt balancing machine. Dynamic balance is held within ½ in.-oz.

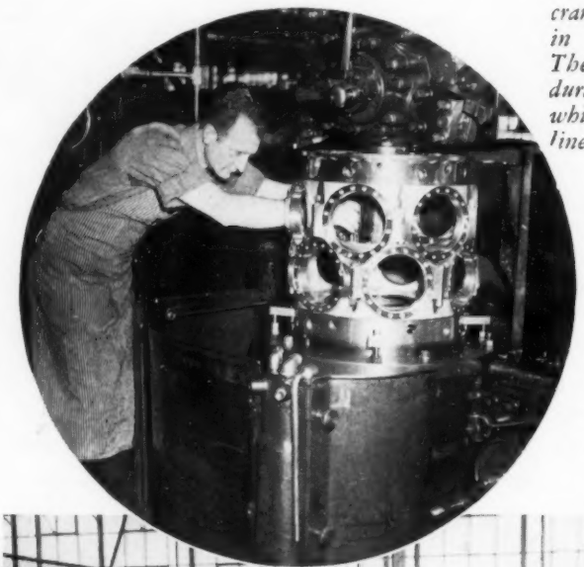
quarter of an hour at the take-off power in five-minute increments. Then the engines are stepped back to 90 per cent of the normal speed for the last hour.

When the engine is stopped it is given a visual inspection for leaks and looseness, and then is completely disassembled. Every part is gone over on a bench by Pratt & Whitney Aircraft inspectors, and the slightest sign of wear or chafing is observed. If the engine passes this inspection successfully, it is turned over to the Army or Navy inspectors should it be designed for either of the services. The parts are loaded on special portable trucks and taken into one of two inclosed cages. For practical purposes, these cages represent Army and Navy territory respectively. No Pratt & Whitney employee is allowed within them except on special permission. In these cages the parts of each engine are laid out on one bench and carefully reinspected.

Upon being passed by the service inspectors, the engines are completely reassembled and sent back to the test house for their final test. The final test consists of a three-hour run: one hour being stepped up from 1,000 r.p.m. to 90 per cent of rated speed, one hour at 90 per cent of rated speed, and one hour at full rated power and speed. This last hour's run comprises the final acceptance test. It is always witnessed by an Army or Navy inspector. These inspectors supervise the progress of the "green" test and final tests.

What has been described is the production test procedure. Pratt & Whitney Aircraft in 1937 completed a special "Power Palace" for more exhaustive tests used in engine development. The Power Palace was built at a cost exceeding $200,000 and is designed to test four engines simultaneously. These test rooms are sound proof to minimize noise and vibration, both inside and outside the building. Each is capable of accommodating engines up to 3,000 hp.

Another test house, with four additional chambers, is now being built in the rear of the present factory. This is a soundproof concrete and steel structure similar to the 1937 building but incorporating improvements and refinements dictated by operating experience of the past year. It further testifies to the fact that aircraft engine design continues to move onward to greater degrees of refinement.



The center liner of a crankcase section is bored in a Bullard machine. The section itself is a duralumin forging in which a bronze center liner has been shrunk

This is Army territory. After the "green" test engines are completely disassembled and laid out, one engine to each bench. Army inspectors carefully go over each part before releasing them for the final test runs

Mild California climate and ample yard space make it possible to expand production greatly by performing assembly operations outdoors. Engines receive their check run-ins here

Flying Boats That Bomb

Consolidated Aircraft had the courage to uproot an older plant in favor of a location that has many advantages in natural facilities

MOST SPECTACULAR flying done by the U. S. Navy in recent years has been that involving the Consolidated PBY patrol bomber flying boats manufactured in San Diego, Calif., by the Consolidated Aircraft Corporation. Official performance of the big twin-engine PBYs remains a Navy secret, but many of the outstanding flights made by squadrons of these planes during the past two years are a matter of public record.

Mass flights of the PBYs have involved as many as 48 planes carrying 336 men on one transocean hop. Routine delivery flights alone have totalled almost a half million airplane miles flown in two years, the official figures being: 422,283 plane miles flown by 147 planes carrying a total of 1,022 crew members. These figures cover only mass delivery flights from the Consolidated factory in San Diego, and not the actual service operations which have followed such delivery flights. Altogether, Consolidated has built and delivered to the Navy more than 200 such planes, whose chief value is their ability to scout vast areas of open ocean for a hostile fleet. And these planes can also carry thousands of pounds of bombs for attack purposes once a hostile naval force has been located.

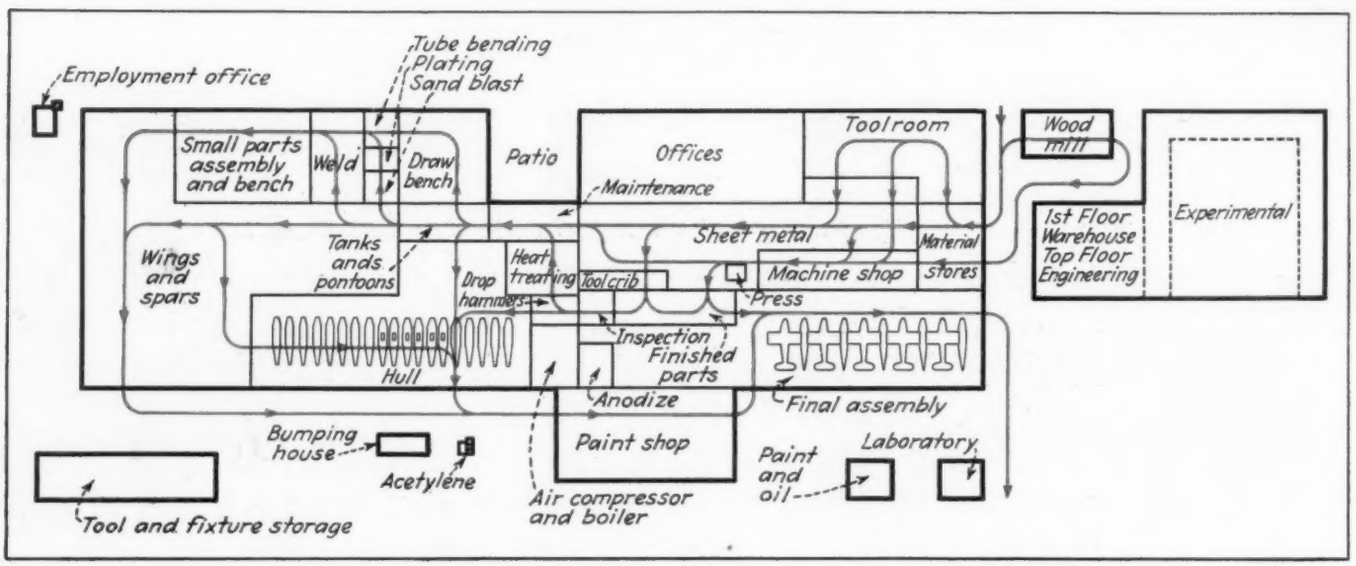
As should be expected, the Consolidated factory is as sensational in its way as are the planes that are built there, and so are the men in the organization that built the factory to build the planes. Consolidated Aircraft Corporation is sixteen years old in May, 1939.

Best example of the daring and resiliency of the Consolidated organization is the move of the entire plant from Buffalo, N. Y. to San Diego, Calif., in 1935. For while the company is sixteen years old, the San Diego plant is little more than three years old. The move to San Diego required selection of a site, planning and erecting of a building with some 246,841 sq. ft. of floor space, at a location almost three thousand miles away. It was necessary to move supplies, tools, and machinery, and some hundreds of workers to the new plant

with a minimum displacement of existing contract work. How well this move was planned and executed, and how well the new factory was planned and built, is demonstrated by the production of more than $20,000,000 worth of aircraft in San Diego since manufacturing operations commenced there in September, 1935. As a result of such planning the Consolidated factory could quadruple its normal peace-time production rate with a minimum of confusion and lost time.

In moving from the Great Lakes area to Southern California, Consolidated eliminated the problems connected with snow, ice and winter weather, which particularly plague the aircraft manufacturer. It was possible to build a factory that was "all windows and doors," of relatively light, long-span roof construction, and without a major heating problem. Weather in the San Diego area is such that planes can be tested all around and adjacent to the central office space. Production starts at the south end of the building, where raw materials flow in from the warehouse across the alley, or from the stock of purchased parts in the material store room located in the south end of the main building.

While production is necessarily broken at many points, the major work proceeds in straight-line flow progression up through the plant from raw stock and material stores, over into hull, or wing and spar departments, back into the paint shop, and then along final assembly to the yard for final fitting work. The toolroom is adjacent to both machine and sheet-metal shops, which promotes efficiency. Furthermore, much of the toolroom equipment is converted to production when initial tooling of a new model has been completed. By grouping the finishing parts stock, tool crib and final inspection in the



Consolidated factory layout is properly designed to arrange the various departments for efficient work flow

most every day of the year and, of equal importance, manufacturing operations can be conducted in the open yard area adjoining the plant. The area under roof at the Consolidated factory now totals 447,332 sq. ft., but there is an additional usable yard area of 212,462 sq. ft. This yard area is inclosed by a high fence and is provided with adequate facilities, such as electric power outlets and air supply.

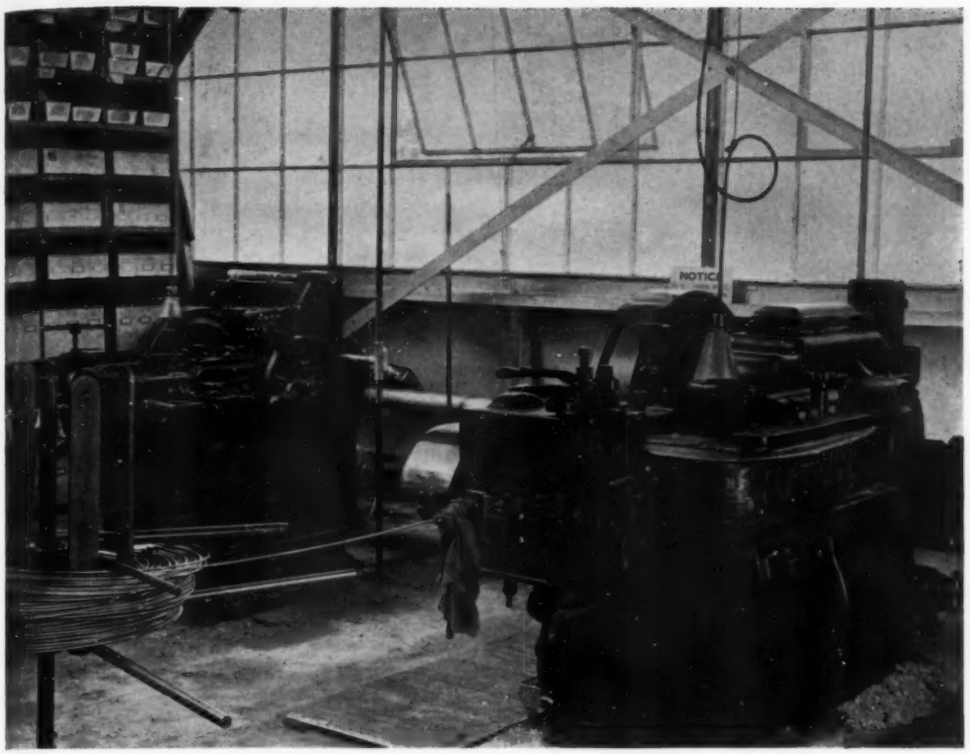
Another advantage of the move to San Diego is the location of the factory adjacent to a protected harbor, permitting prompt launching of flying boats when completed. This proximity of water facilities aids materially in conducting extensive flight test programs where close liaison with factory personnel is necessary.

The Consolidated Aircraft factory is built on Lindbergh Field, the San Diego municipal airport which is adjacent to the business district. Although the Consolidated plant is on the land side of the airport, nearest railway and highway facilities, there is a seaplane ramp on the bay side of the field and dock facilities are close at hand. Thus the factory has available every type of transportation for the receipt of supplies and raw materials, or for the delivery of finished aircraft and parts for land or water service.

The plant is built on a 35-acre site, most of which has been reclaimed from bay tide-land. Investment in plant and equipment totals more than $2,000,000. This includes approximately $500,000 now being expended on modernizing the factory facilities in the light of aircraft production methods which have been developed since the factory was built in 1935. While it may sound fantastic to speak of "modernizing" a plant that is now less than four years old, this is exactly the case. One of the major items of new equipment is a battery of presses and drop hammers of large capacity to handle new sheet-metal production methods.

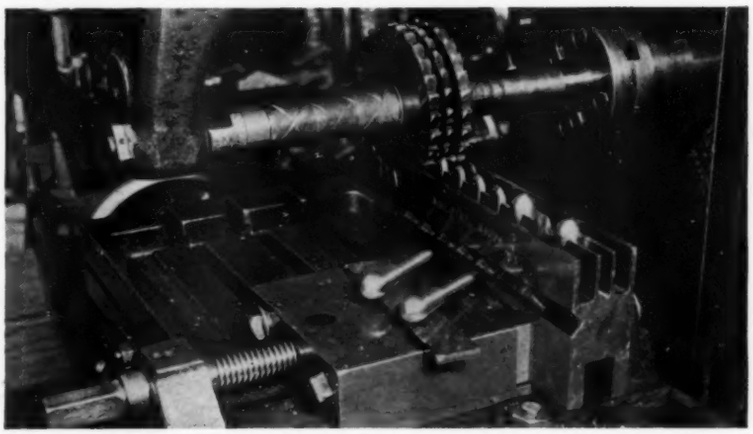
Layout within the main factory building has been planned for smooth flow of work from raw stock to final assembly. The offices are located at the center part of the front, or highway side, of the building. All production departments are arranged center of the plant near the heat-treat, drop hammer, anodize tanks, paint shop, and plant maintenance shop, it is possible to reduce lost motion to a minimum on small parts handling. Parts and materials flow naturally from raw stores, material stores, and finished parts stores over in the small parts assembly and bench work department, and from that point into wing and spar, or hull assembly, which is but one step removed from final assembly. After final assembly the planes are moved out into the yard for installation of interior fittings and accessories.

Extending through the entire plant is a complete overhead mono-



Rivets of many sizes and shapes to the tune of a million a week can be turned out on these two machines. They are then heat-treated and stored in electric refrigerators until ready for use

An airplane calls for a multitude of small machined parts. Here cable terminals are being straddle milled in a special fixture

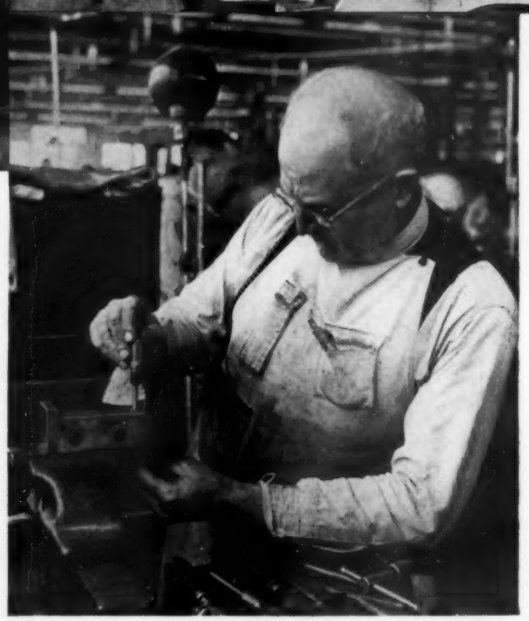


The thin sections and curved contours of duralumin parts lend themselves to roll forming. The cold working of dural increases its strength

Machine tools employed for tool-work are turned to production operations as soon as the tools are completed. Here is a large radial drill employed in making a fixture part; it is also used for machining steel tube engine mounts

Sheet metal operations play an important part. A 14-ft. Cincinnati shear is shown being set up in the department devoted to this work

The initial set-up of a special louver die calls for special care. Other punch presses handle a multitude of blanking, forming, drawing, notching, perforating, crimping, slotting and burnishing operations, and even some small shear work



Skilled toolmakers play an important part in aircraft production; they build the foundation work for the accuracy that must go into the finished product

rail system with a total length exceeding 7500 ft. The monorail system is most complete in the paint shop, where parts are routed along a dozen different parallel tracks, with hundreds of ropes used to suspend parts ranging from small pieces of sheet metal to entire wing panels. Almost the entire back of the factory building, and both ends of the paint shop, is made up of doors. These can be opened at any point. In conjunction with the monorail system this makes it practicable to shift hulls, wing or semi-finished planes from point to point without disturbing the balance of the production line.

Emergency expansion of production can be accomplished quickly by moving all final assembly out into the open yard, and by erecting temporary buildings just east of the main plant, across the boulevard, to house small parts assembly. Further plant facilities could then be provided, if needed, on land available to the north of the present main building. None of this would materially affect the smooth flow of production in the existing plant.

As the company neared the end of its current production contract on the PBY type planes recently, a major program of maintenance work and new equipment installation was undertaken in connection with heavier production requirements of work to be undertaken in the near future. A $500,000 equipment program included three Brown & Sharp automatic screw machines, two Cleveland screw machines, a Cincinnati centerless grinder and a LeBlond gap lathe to swing 50 in.

For the drop hammer die foundry two James H. Knapp gas-fired tilting type melting furnaces were installed, each with a capacity of 8,300 lb. of zinc alloy, or 12,000 lb. of lead. To supply the power for the new air operated drop hammers a new Worthington 20 x 12 x 14-in. horizontal two-stage compressor was added. It is of interest to note than a standby system is provided to supply butane gas to the boilers, heat-treating equipment and furnaces in the event of failure of the natural gas supply, piped from Los Angeles. Some 10,000 gals. of butane fuel are stored at the plant, enough to meet normal needs for a a full ten-day period.

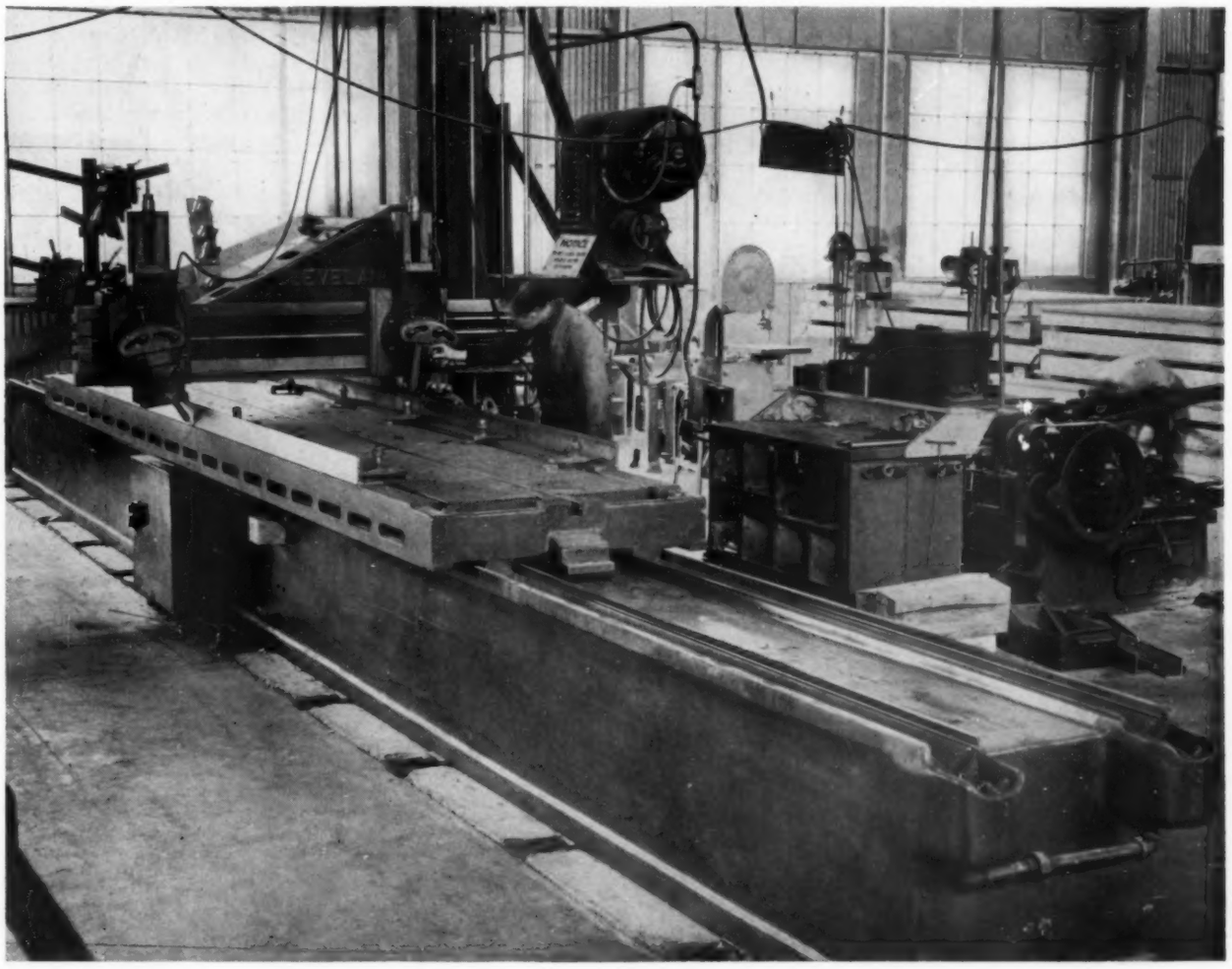
Included in the machinery purchases have been a 4500-ton hydraulic press, a Hamilton double-crank 1000-ton press, four Chambersburg air-

operated drop hammers, and four new rope lift type drop hammers designed and manufactured in the Consolidated shops. The 4500-ton hydraulic press is built by the Birdsboro Steel Foundry and Machinery Company in conjunction with the Hydraulic Press Manufacturing Company. The double-crank Hamilton press is a single-action blanking press of 1000-ton capacity, manufactured by the Hooven-Owens-Rentschler Division of General Machine Corporation. The two presses are being installed in the center of the sheet-metal department. The four air-operated drop hammers are all of Chambersburg manufacture. Two smaller Chambersburg hammers are also being installed, each with a stroke of 42 in., and a platen area 41 by 36 in.

The drop hammer installations are new, such work having formerly been contracted to outside manufacturers. It is notable that the drop hammers are being installed in the center of the main factory, immediately adjacent to the machine shop and close to the offices. Drop hammer installations have always been a source of concern due to the heavy vibrations imparted to their foundations, and through the soil to buildings and equipment in the vicinity. It is of interest then, to note the installation of unusually large hammers right in the heart of the plant; and the installation has been further complicatetd by the fact that the entire factory is built on reclaimed soil filled over tidelands, with a bearing value of only 1,250 lb. per sq. ft. So it was necessary for the engineers to solve simultaneously load bearing and vibration transmission problems. The load bearing problem was solved by driving H-type steel piles to a depth of 60 ft. to serve as a sub-foundation. As the roof clearance was only 30 ft. it was necessary to drive the piles in short sections, welding additional increments in place as the driving progressed. Shocks have been kept within the foundations (subject to working demonstration) by mounting the drop hammers each on a heavy inertia block which is, in turn, suspended in a foundation box by means of heavy coil springs. The heavy concrete foundation box rests directly on the steel piles driven in the sub-soil. The inertia block is floated in this box from steel beams at the top resting on Korfund coil springs supported on the foundation proper. It is estimated that the maximum deflection of these springs on the largest of the Chambersburg hammers will not exceed ½ in. In order to save foundation space it was found necessary to make the inertia blocks of something with a specific gravity heavier than concrete. This was done by using steel punchings and scrap as aggregate in mixing the concrete for each of the inertia blocks. The inertia block is heavily reinforced with steel to keep it from disintegrating under the pounding of the hammer.

An aircraft design has called for metal construction to a constantly greater degree, the importance of the machine shop to airplane production has increased. But many metal-work-

Construction of large production fixtures requires some good sized machine tools in the toolroom as exemplified by this open-side planer



ing processes not a part of the machine shop proper have also been required increasingly. Wood has been eliminated so completely from the PBY type that the only place it is used is for the top of the navigator's table, and small pieces in the pilot's seat arm rests. Future designs will probably continue this reliance on metal and will call for more efficient metal-working equipment. Nor is the metal all of a kind, for many different alloys, and structural forms, go to make up the completed PBY. There is extensive use of riveted sheet aluminum alloy in the skin of hull and wing. Welded steel tubing is used in the engine mount. Liberal use of forged dural parts is made throughout the plane, and these must all be machined. Spot-welded dural and stainless steel sheet parts are also employed. And dural tubes and extruded sections are used at many points.

This means that metal-working methods have had to be applied and developed to fit the particular needs of PYB production. Outside the machine shop there are the metal shears and brakes, the heat-treating furnaces, the plating and anodizing equipment, welding shops, tube bending, cable terminal, swaging machine, presses, drop hammers, draw bench, hand and machine riveters, and miscellaneous other such equipment. To keep all this metal-working machinery going a highly efficient tool-crib system has been worked out by which one master tool-crib distributes supplies to eight cribs located in or near eight separate departments.

Some conception of the bulk of metal parts handled in the manufacture of large aircraft is provided by the size of the anodizing pits, which are 20 ft. long and 15 ft. deep. Here aluminum alloy parts or assemblies are given a protective coating of aluminum oxide prior to painting. The same emphasis on size is found in the paint shop. Here facilities have been completely revamped through installation of new spray booths of the water wash type to take the paint residue out of the exhaust air.

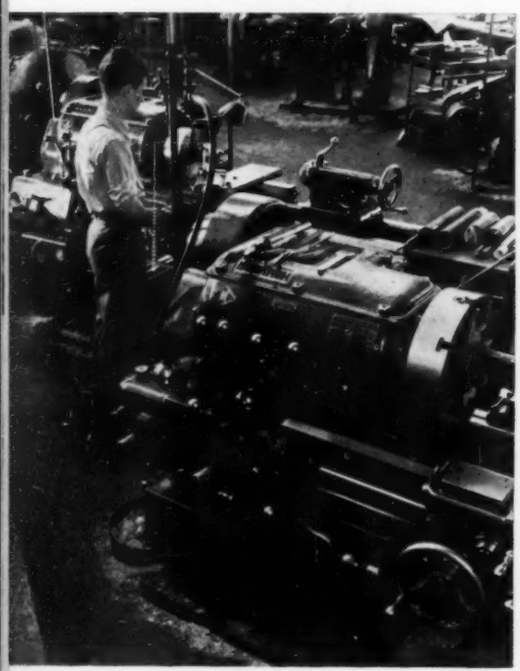
To keep pace with the ever increasing size of parts a new salt bath furnace is being installed in the heat-treating department, with a capacity to heat-treat 2,000 lbs. of aluminum alloy parts per hour in a salt pot 21 ft. long, and requiring approximately 18,000 lbs. of potassium nitrate and the same quantity of sodium nitrate for its initial charge.

In the sheet-metal shop we note a Cincinnati brake with a 10 ft. throat which is extended to 15 ft. by end brackets for light aluminum alloy work. And a Cincinnati shear with a 14 ft. throat is used for trimming large sheet metal parts. A battery of Niagara punch presses handles a multitude of blanking, forming, drawing, joggling, notching, perforating, nipping, dimpling, crimping, slotting and burnishing operations, and even some small shear work. As with all metal-working machinery in an aircraft plant, each machine is required to handle a wide range of work, and every operator must be versatile in handling a number of operations satisfactorily.

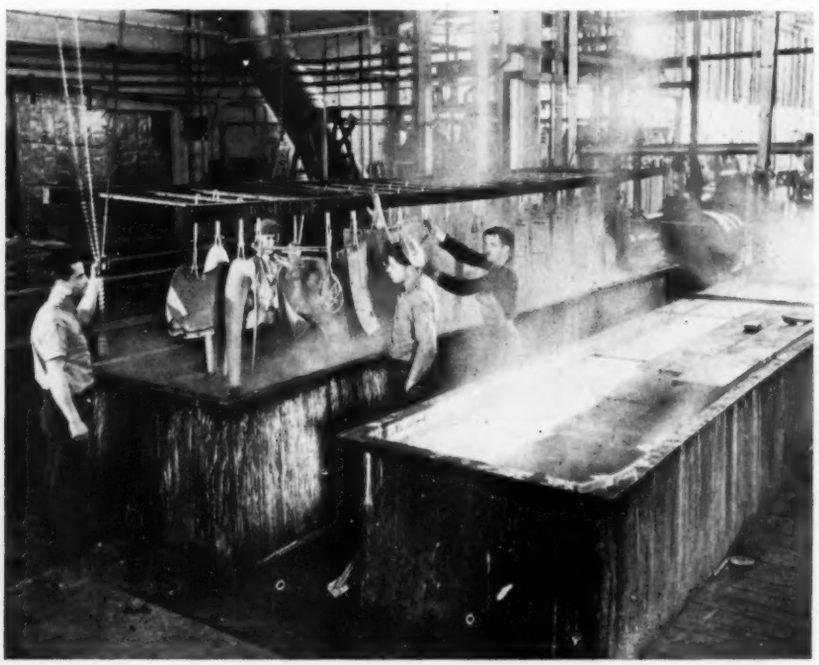
In order to get the maximum use from the punch presses a complete system of dies has been worked out, including spring die sets, magnetic die holders, notching and slotting dies held in special die sets, and a fascinating technique in handling joggling dies. Joggling, off-setting, or crimping, is of special importance as it is frequently necessary to joggle a plate, or extruded or drawn section, in order to assemble a complex fitting properly in the airplane structure. A clever system of joggle dies, using a sliding shoe and return springs, serves to convert the vertical motion of the press into a desired transverse and angular motion to achieve the various degrees of joggle required.

A separate phase of sheet-metal work is the draw bench, where strip stock is drawn through dies to produce various channel forms. These are then heat-treated and pulled in a stretcher to just beyond their yield point in order to straighten them. A great deal of tube bending is required in connection with plumbing, conduits, and some structural parts. Nearly 900 ft. of tubing is used in each PBY and most of this is bent at some place or other. The motor mount ring is rolled in a ring-rolling

These engine lathes are typical of the modern machine equipment employed



Anodizing follows the machining of all duralumin parts; it adds a protective coat of oxide, an effective means of inhibiting corrosion



machine. The beaching gear strut is bent in a die on a press. But most of the bending is done on a set of tube bending machines instead of by the old hand bending methods. On control cable ends the old method of hand splicing a loop is eliminated through use of a Standard Machine Company swager with which the terminal ends are swaged to the cables. Cold working of the stainless steel terminals during swaging improves their strength also. A "cable-proofing" machine built in the Consolidated shops takes initial stretch out of all cables prior to their installation.

All rivets used in the plant are produced on two rivet headers, one National and one Manville, which turn out as many as a million rivets a week of varying sizes and types. As there are a great many different rivet sizes required in the construction of such a large plane it has been found more satisfactory to manufacture the rivets as needed rather than to carry them in stock. Another factor is the close control that must be maintained on rivet heat treat. After heat-treat the rivets are stored immediately in a large electric refrigerator to keep them from aging prior to driving. This refrigerator serves as supply headquarters for some 37 small electric refrigerators throughout the plant. The small refrigerators are on wheels and may be moved about to suit the convenience of the various rivet driving crews.

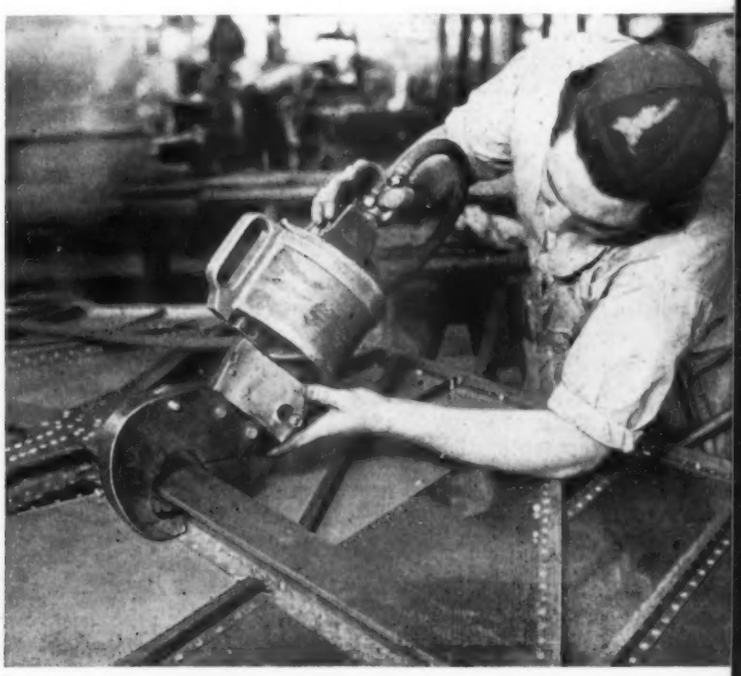
Machines methods of a portable kind have been applied to many of the sub-assemblies built up in the welding shop. These bulky assemblies do not lend themselves to handling in the machine shop and are faced, drilled, and reamed at attachment points, or where accessories mount, through use of special fixtures and jigs, with boring bars, spot facers, reamers, etc., all operated by hand electric or pneumatic motors.

But the heart of the PBY production program, or any other metal plane that may be produced in the Consolidated plant, is in the machine shop and toolroom. All production starts in the toolroom with the manufacture of jigs, fixtures and special tools. But so important is elimination of lost time between final design and finished product, because of rapid design obsolescence, especially in the

Pneumatic tube-bending machines are now coming into play. The Model 28 Consolidated twin engined flying boats use approximately 900 ft. of tubing per plane. It finds a place in extinguisher lines, fuel oil lines and for conduit

For experimental work power hammers, such as this, give gentle curves to large aluminum sheets

A squeezer upsets the rivets in a large bulkhead for one of the Consolidated planes



The hull assembly line shows the partially completed hulls of the twin engined Model 28 flying boats

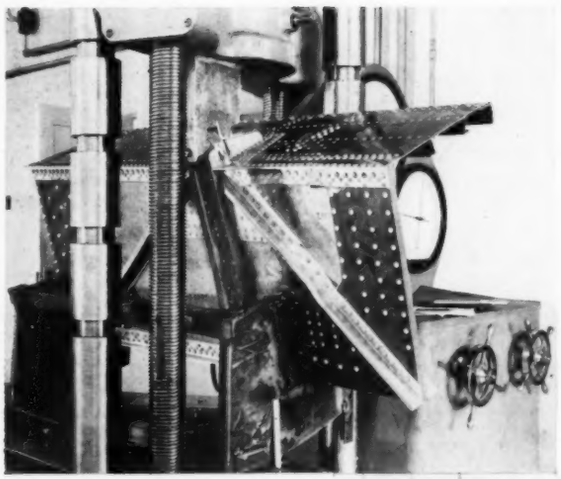
military field, that production of a new type is usually started through the machine shop simultaneously with tool and fixture orders that go to the tool shop. As special fixtures become available they are placed in the production line, but production does not wait for them.

Consolidated performs 85 per cent of all machine work in its own shops and is well equipped for the full range of work required in turning out a plane of such size as the PBY. Toolroom equipment ranges from the huge Cleveland planer with 30-ft. bed to the Swiss jig borer used on precision jig work. Most blanking dies now are made on the DoAll Metal-Master from $\frac{1}{8}$-in. crucible steel sheet, with a hardened punch $\frac{1}{8}$ in. thick, at a cost of a third that of the conventional blanking die. The operation with such dies is a little slower, but the work is entirely satisfactory and it is economically possible to make a die for production lots as small as 30 where previously at least 180 parts were required in a run to pay the die cost. Other special toolroom equipment includes a Pratt & Whitney surface grinder, and a Fosdick radial for large jig and fixture work; in addition to the usual battery of lathes, mills and shapers.

Another development that keeps the toolroom busy is the use of metal-forming blocks in place of the customary wood blocks for miscellaneous assembly jigs. Wood blocks have the advantage of cheapness, but the disadvantages of being subject to warping, cracking and weather changes which produce inaccuracies in the work. The wood blocks also wear rapidly and become unsatisfactory for precision assembly. Such blocks are widely used for all flat-plate assembly layouts such as for ribs, bulkheads and spars. Making such blocks and formers of cast iron or steel is prohibitively expensive. But at the Consolidatetd plant, they have hit on the happy idea of having a local foundry melt up all the aluminum and duralumin scrap and cast it into standard slabs, rods, channels, and other shapes lending themselves to jig and former work, and forming blocks. The light alloy material works up easily into the desired shape, but it makes added work for the toolroom and is another example of the use of metal in aircraft production. Much less expensive than steel or cast iron, the alloy blocks hold their shape throughout a production run, do not chip or wear, and so more than pay for themselves through speeding assembly operations and insuring greater accuracy of assembled parts.

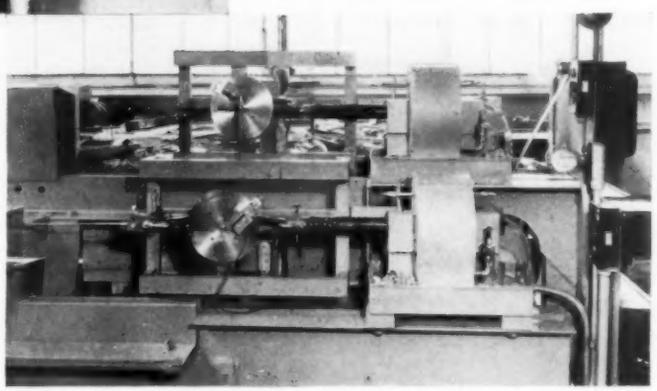
Since each new aircraft design represents an entirely new tooling problem it has been necessary to work out tooling methods that will cause a minimum of delay in production, and still produce satisfactory tools. All frills are eliminated as tools are usually for short runs of a few hundred parts at the most. Relative importance of tooling work is shown by the fact that the toolroom is about equal in size and equipment to the production machine shop. An interesting result is that when tooling is completed on a new model, the toolroom goes into production on aircraft parts just like the rest of the machine shop.

Much of the aircraft work is bulky, or light and springy, and special set-



Engineering advances are checked and developed in the physical testing laboratory. Here is a sample wing fitting set up in a 200,000 lb. Southwark-Emery testing machine

Steel parts are heat-treated in furnaces such as this



The power end of the cable stretching machine is shown. Having a capacity of 20,000 lbs., it was designed and built by Consolidated Aircraft for prestretching all control cables that go into its ships

ups are required in practically every case. Some production machine work is done, as in the case of rollers, bushings and collars produced on the automatic screw machines or on turret lathes. However, a much more typical operation is the machining of an odd-shapped strut of welded chrome-molybdenum steel, on which the attachment end requires a facing operation held to close tolerances. This requires a set-up in a Cincinnati vertical mill so that the strut leg can extend out over the table. Another particular problem involves back spot-facing of an odd shaped bulky alloy casting; or the machining of a long thin taper on a duralumin fitting.

A special set-up has been developed for such scarfing, or taper work, as there is a considerable amount of it. A multitude of odd-shaped small machined parts are used throughout the airplane and many special set-ups have been developed to handle them. One such is a channel block fixture in which cable terminals are held by means of setscrews while a triple straddle mill job is done on a horizontal mill to machine out the terminal slot and simultaneously face both outside surfaces of the fitting. This fixture accommodates six terminal ends per operation. Much precision grinding is done in connection with bushings and rollers required for the control system. This work has become so important that a new cenerless grinder was recently installed.

Another example of the difficult machine work required is the spot facing of the engine mount attachment points which are built integral with the center-section oil tank. This tank serves the three-fold purpose of a tank, a part of the wing nacelle truss and the base for the engine mount. After the tank has been built and tested it is sent to the machine shop for spot facing of the attachment points. In order to do this job at all, and to do it accurately, set-up was worked out on a Dreses radial drill through use of a floor segment arc track which carries a strut to support the swing drill arm. The purpose of the track and strut is to prevent any tendency of the long overhang of the drill to cause spring, resulting in chatter, or spotfacing out of an accurate plane. The strut is carried over the track on rollers so that it is practicable to swing the arm past the work with the spotfacer mounted in the drill head. A special jig is required to hold the tank during this operation, to insure accuracy, as the tank is quite bulky, measuring $1\frac{1}{2}$ x $2\frac{1}{2}$ x 4 ft. in size.

Matching the four spotfaces on the oil tank are the four faces of the engine mount. The engine mount structure is bulky and awkward from a machining standpoint, yet the mounting faces must match those of the tank. To accomplish this the entire engine mount, which is a welded steel tube structure, is placed in a large jig and the four attachment points spotfaced in a radial drill. Then, using these four spots as the set-up face, the work is mounted in a special fixture while the engine attachment lugs on the opposite end of the mount are straddle milled in parallel with the spotface plane. Because of the open nature of the engine mount structure the danger of springing the work has to be carefully guarded against. A small allowance

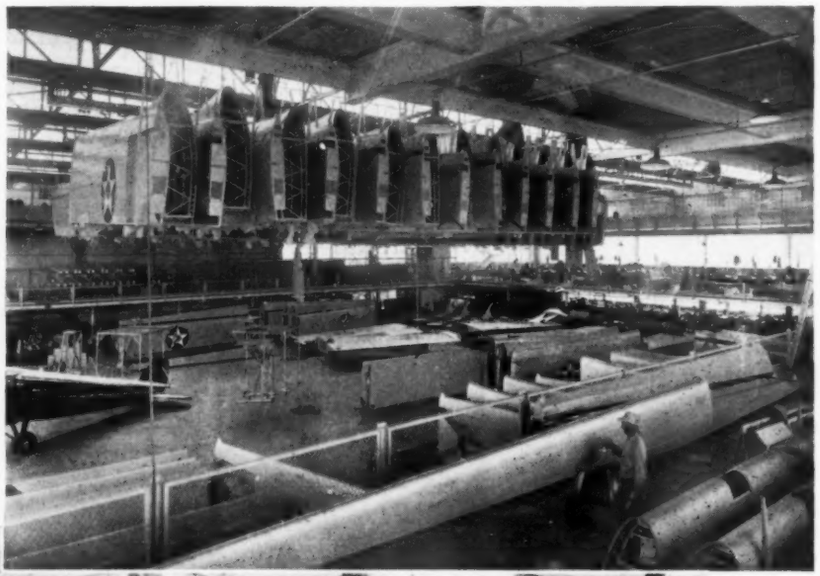
in the welded structure is provided for machining.

Throughout assembly work one particular tool plays an important part. This is the riveter, which is used in many forms. There are hand rivet guns for driving rivets, hand squeezers for one-shot operations, machine riveters, special rivet jigs with side throat yokes for rivet squeezing on large assemblies such as spars.

Almost innumerable devices have been developed to speed final assembly. These range all the way from the simple expedient of filling the hull with water to see if it leaks, to the roll-over rings by which the hulls are hoisted and turned when the bottom has been skinned and it is time to start on the top. Final attachment of the outer wing panels to the center section is done out in the open yard with a hoist rack actuated by automobile differential drives operated by a drum and cable system which takes the wing from a low loading level up to the attaching position. The rack is mounted on rubber tired wheels to permit maneuvering the wing panels into position with minimum effort.

The final airplane truly represents a machine-made product from nose to tail. In wings, hull, and tail hundreds of machined fittings, struts, and structural or control parts take their place in a flying boat that is literally born in the machine shop.

Some of the work back of the production line is not apparent, even to the close observer. For example, the physical and chemical laboratory is constantly testing parts and materials to destruction; and the photo laboratory makes 7,000 negatives and more than 20,000 prints yearly to serve as a detailed guide for engineering and production departments. These photographs aid in maintaining an unfailing standard, so that each completed PBY will be identical with her sisters.



In the experimental building, all new projects of plane design are conducted. If necessary this area could be turned over to production

Assembly devices range from wood boards, similar to those shown in the foreground, to the big hull assembly fixtures in the background. For the large fixtures steel is employed

Diesels for the Deep

Fairbanks Morse makes the motive power for submarines, and auxiliary units for all other types of naval vessels

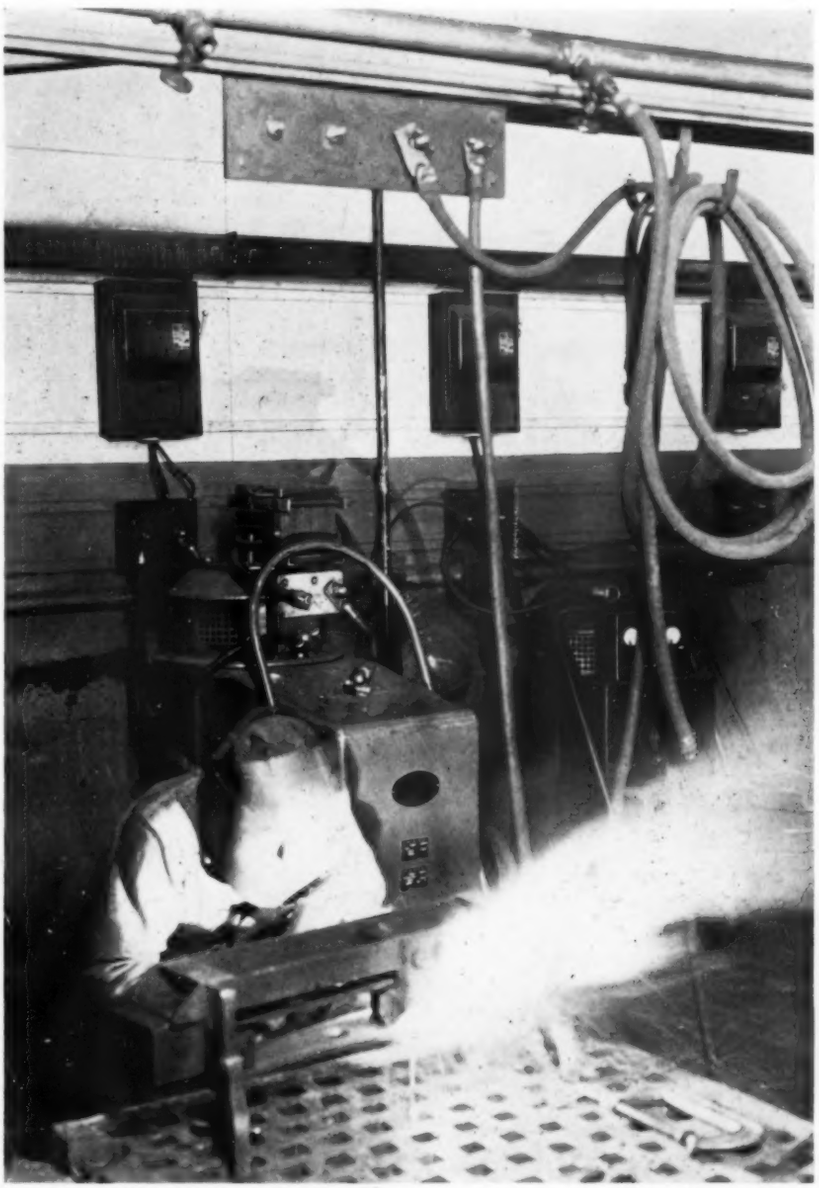
THE REVEREND Leonard H. Wheeler, a missionary on the Bad River Ojibway Indian Reservation, moved his mission from Odanah to Beloit, Wisconsin, in 1867. In the same year he patented a windmill—the first one with hinged vanes which threw the wheel out of gear when the wind reached a certain velocity.

In 1880 C. H. Morse joined forces with the Wheelers and the business of their newly formed Eclipse Wind Engine Company was so successful that in 1886 it bought the plant "on the hill," then known as the Beloit Wagon Works—the present site of the Fairbanks-Morse Beloit plant.

Eclipse was later absorbed in Fairbanks, Morse & Company which entered the internal combustion field in 1893 with an agreement to build the Charter engines whose patents date back to 1887. Its first marine engine, the Simplex, was built in 1900. Since that time the company has continued to improve and develop its engines and in 1934 the company introduced a two-cycle opposed piston diesel designed for marine and electric service.

This design overcame certain difficulties considered inherent in the opposed type engine at the same time retaining its possibilities of high efficiency, light specific weight and high operating speeds. Development of this diesel, a great portion of which is welded construction, has been carried right along with many of this general type now in naval service. Plant arrangements have been revised and modernized to accommodate construction of the new engines. New precision and production tools are being added as required to improve accuracy and to cut costs.

These diesels are supplied to the Navy for generator sets on sub-



Miscellaneous parts such as oil pan, manifold and others are welded on any one of several steel tables which are about 4 ft. wide and 12 ft. long. All 180 cycle a.c. is used to avoid magnetic load. Portable units are grounded on steel plate while live lead goes to overhead panel which has provision for as many as four leads. Air hose also is carried on overhead frame

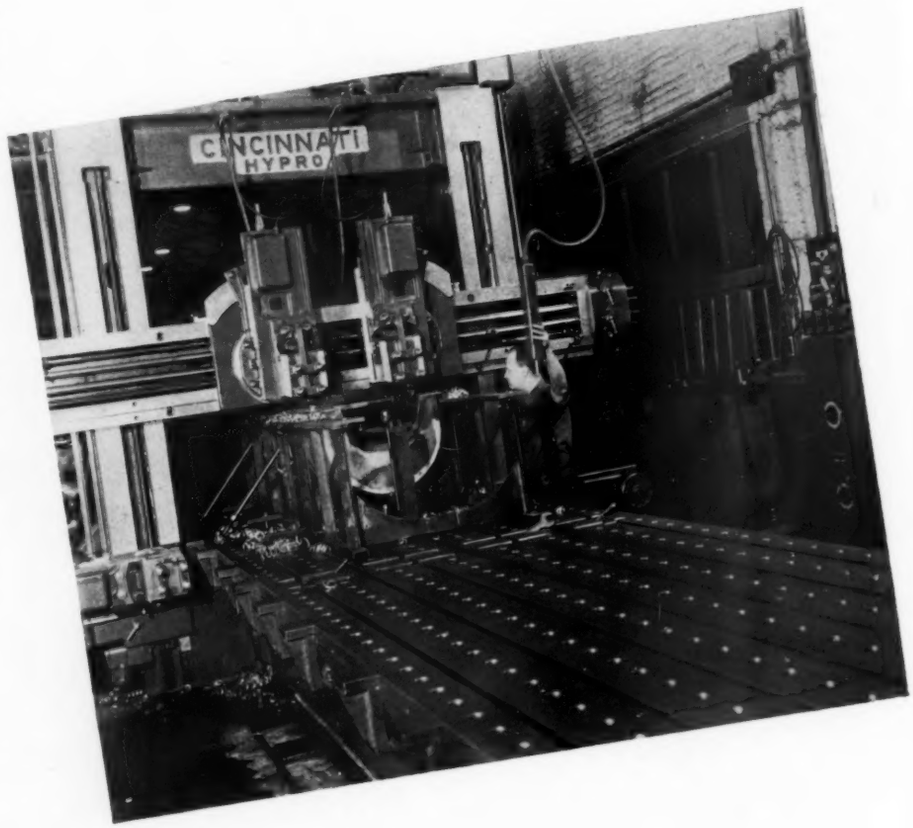
marines, battleships, aircraft carriers and other ships. Capacities of the sets range from 500 up to 1200 kw. with the largest, a nine-cylinder size for submarine service, having a 1600-hp. rating. The operations described are typical of the work done, whether on the five- or on a ten-cylinder size, since the only change is in the length of the block; capacity is increased by the addition of cylinders of standard size. Production is running about one engine per week at the present time on a regular eight-hour shift. In an emergency this can be readily increased.

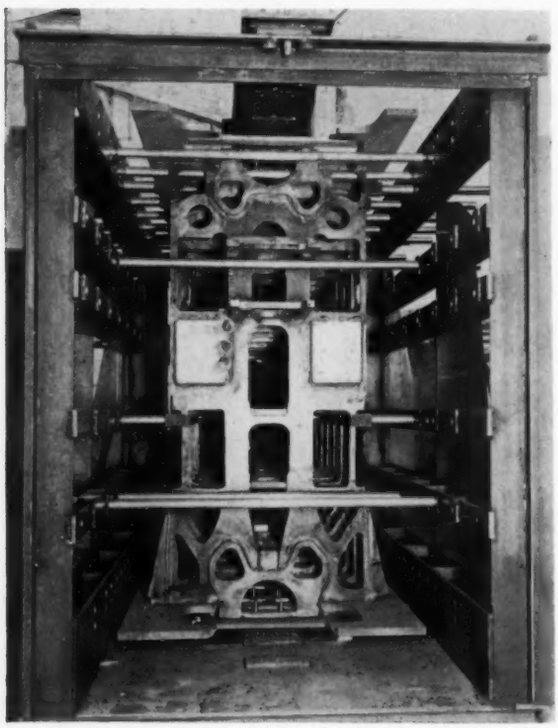
Dimensions must be exactly as specified by approved blueprint; tolerances required are generally closer than for industrial engines. No cut-and-try methods of fitting are permissible. No scraping or filing is desirable as all pieces must be interchangeable.

Manufacture of the engine involves several departments of the Beloit plant of the company. Roughly they are: flame cutting and welding, a shop for large machine tools where welded parts are machined, shop for smaller machine tools for miscellaneous work, precision machine shop for fuel pumps and other smaller precision parts, crankshaft shop, heat-treating shop.

The extent to which flame cutting and welding has been used in the manufacture of these engines is remarkable. Practically the entire structure begins its career in sheet steel form in thicknesses from $\frac{3}{16}$ to 6 in. Continued experimentation and development work has reduced effect of shrinkage due to flame cutting, sub-assembly welding and final welding down to about $\frac{5}{32}$ in. in developed lengths of engine block of about eight feet.

Bottom and top of block are shaped in this machine (shown here working on the welded oil pan held in welded jig). Machine has 28 ft. stroke and bed is long enough to accommodate two blocks at once. Having wide range of feeds and speeds with quick return this machine is fast and accurate, works to tolerances of 0.001 in. on bearing fits on bottom of block



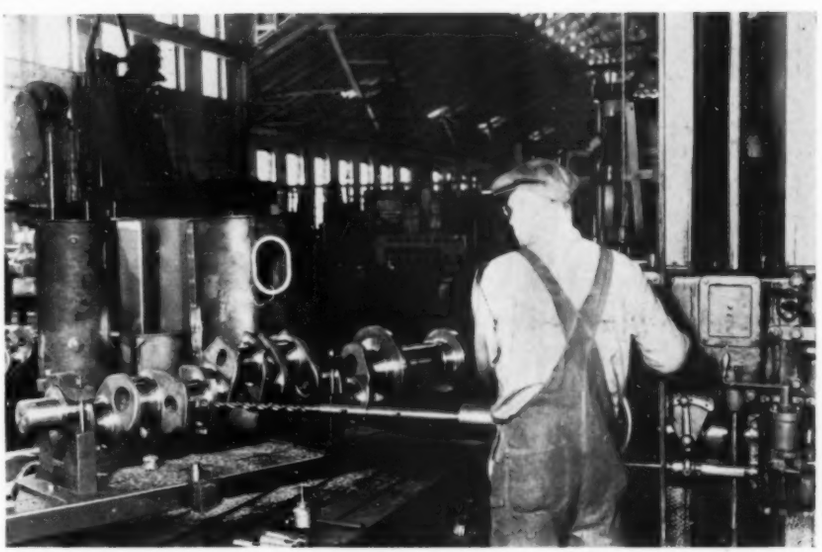


Jigs are important throughout building up of engine block because accuracy of completely welded block is essential. This assembly jig was built to a tolerance of 0.005 in. V-blocks on end of the short horizontal bars support vertical frames while through-bars support horizontal engine block members. Dowel plates, top and bottom, center the frames and hold them in alignment

Precision of flame cutting practice has been developed to the point where there is no necessity of milling the slots for the joints between frames. Tolerances are $\pm\frac{1}{16}$ in. although parts are commonly held to $\pm\frac{1}{32}$ in. as a standard production procedure. Metal templets are used with a magnetic tracer on the machine. They are stored just like patterns would be for a foundry. Instructions on procedure are kept with each templet. Practice has been so developed and standardized that most flame-cutting jobs are on a piecework basis.

The block and other parts such as the manifold and oil pan are welded in one section of the shop which is equipped with low steel

Cam shaft bearings are line bored using high speed tools on roughing cuts at about 29 r.p.m. with a feed of 0.006 in. and Carboloy tools at 35 r.p.m. for finishing. Coolant is supplied to cutting tools by overhead pipe with individual valve for each bearing location. Continued accuracy is assured by regular inspection of boring bar and tools



After first balancing, crankshaft oil holes are drilled with this horizontal drill with movable table. Holes are held to tolerances of 0.0005 in. on diameter

tables, movable and fixed jigs. Subassemblies are usually welded on one of several heavy steel plates, about 4 ft. x 12 ft. which are ground to the portable welder nearby. Arc welding is used throughout, 180 cycle a.c. being supplied by the welding machines through an overhead panel board which provides connections for as many as four leads to electrodes.

A tilting universal jig is available for sub-assemblies such as engine frames. Assembly of the block begins in a fixed jig made to tolerances of 0.005 in. on important dimensions. Much of the welding on the block is completed in the tilting jig shown in one of the illustrations. Some welding is completed on the floor after which all stressed joints are magnafluxed with a portable machine using the dry powder method. Any defective welds are corrected by rewelding. The parts then go to the heat-treat department for stress relieving in a car-bottom furnace.

After stress relieving the welded parts are returned for machining. The majority of the work is done in four machine tools. The block is first put in a planer with a 28-ft. planer table for shaping top and bottom surfaces for crankshaft bearing fits. Tolerances on flat surfaces for main bearing blocks is 0.001 in. A planer is used because it furnishes necessary flexibility for several jobs and is fast because set-up time is reduced; large surfaces can be machined rapidly. Crankshaft bearings and cylinder support decks are bored and ends of block are milled in a large boring milling and

Races of Swedish steel for the needle bearings used in connecting rod are internally ground to tolerances of 0.005 in. on diameter

drilling machine, which is equipped with an auxiliary table for blocks which are too large for the regular table. Short round bars have previously been welded to the sides of the block to assist in handling setup. After this the camshaft bearings are bored and line reamed in another horizontal boring machine. Holes are drilled and tapped with a radial drill mounted over a pit. The block is then ready for the final assembly floor.

One of the few non-welded parts on the engine is the blower housing which is a double-walled aluminum casting. One face is bolted to the end of the engine block with an aluminum cover plate bolted to the outside end. All holes for these bolts are drilled and tapped in a radial drill using a flat steel plate with guide bushings for a jig.

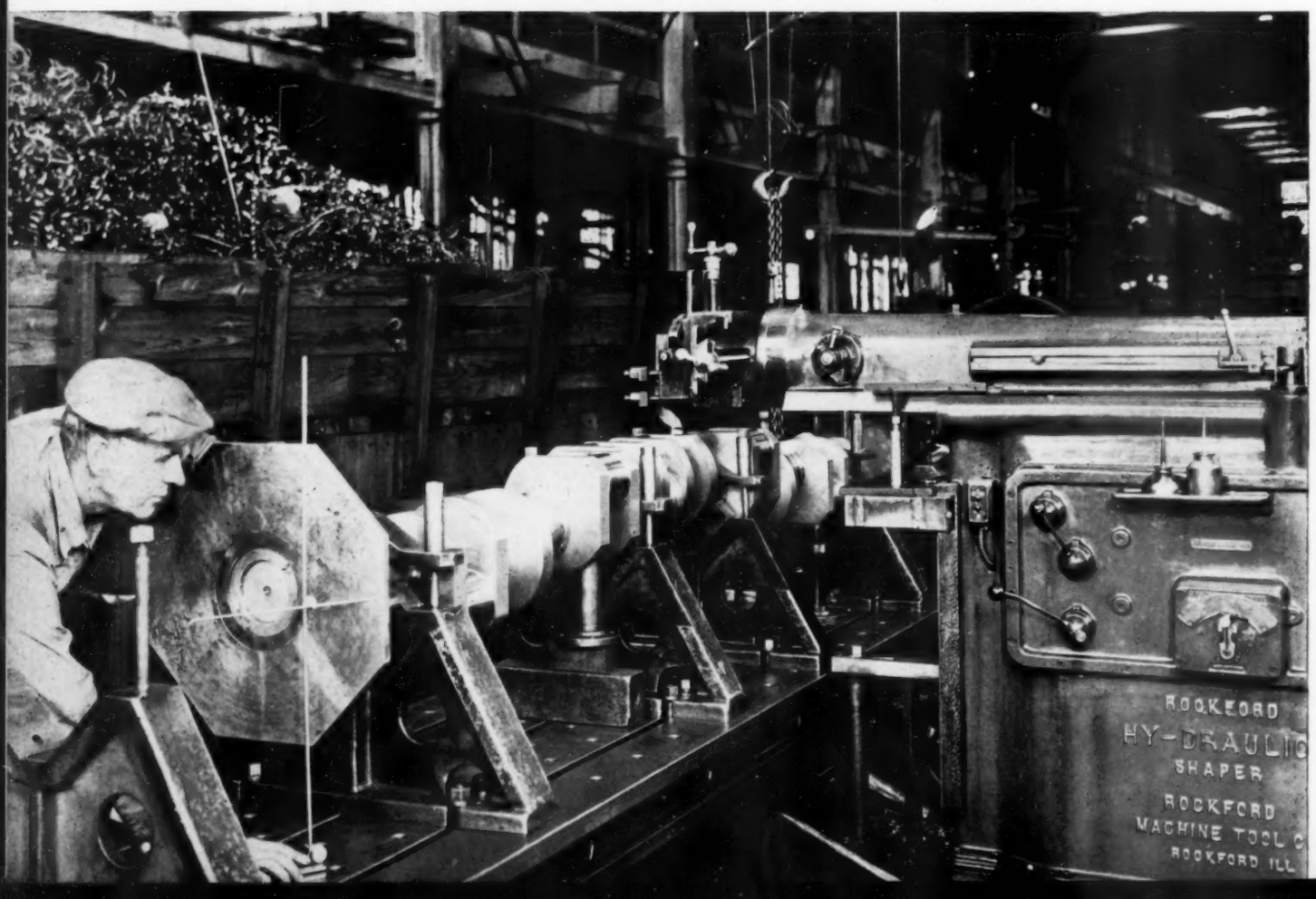
On body fit holes, requirements are that holes must be reamed absolutely smooth and round. Tools are kept carefully ground at all times. Both sides of the housing are finished in a hydraulic shaper with a planer table. The inside bores for the impeller are rough and finish turned in a boring, drilling and milling machine to ± 0.002 in.

The spiral flutes of the cast aluminum body of the impeller are shaped in the same machine which is used for the housing. A special indexing jig and machine head, shown in one illustration, gives the proper finished lead to the flutes. An engine lathe is used to turn the steel shaft which is slotted and grooved to hold the aluminum which is cast around it. The outside diameter of the impeller is also turned at the same time, both operations being done prior to shaping the spiral. Tolerances on the diameters are ± 0.002 in.

Other parts such as gears, wear rings, cylinder liners and pistons are machined in another shop equipped with smaller capacity machines such as standard radial drills, milling machines, engine lathes and so on. Here also is a machine which was rebuilt to meet production requirements on boring the cylinder liners. Another time-saving and accurate machine just installed is a boring machine with two movable spindles and a jig arranged to bore both ends of the connecting rods at one time to close dimensions for needle bearings.

Arrangements in this as well as other departments must include provision for company inspection. The inspection benches for the two groups are placed next to each other so that parts flow from machine to company

Indexing for position of cheeks of forged crankshafts which are finished in this hydraulic shaper with the planer table. Permanent fixtures on table can be blocked to accommodate various sizes of crankshafts



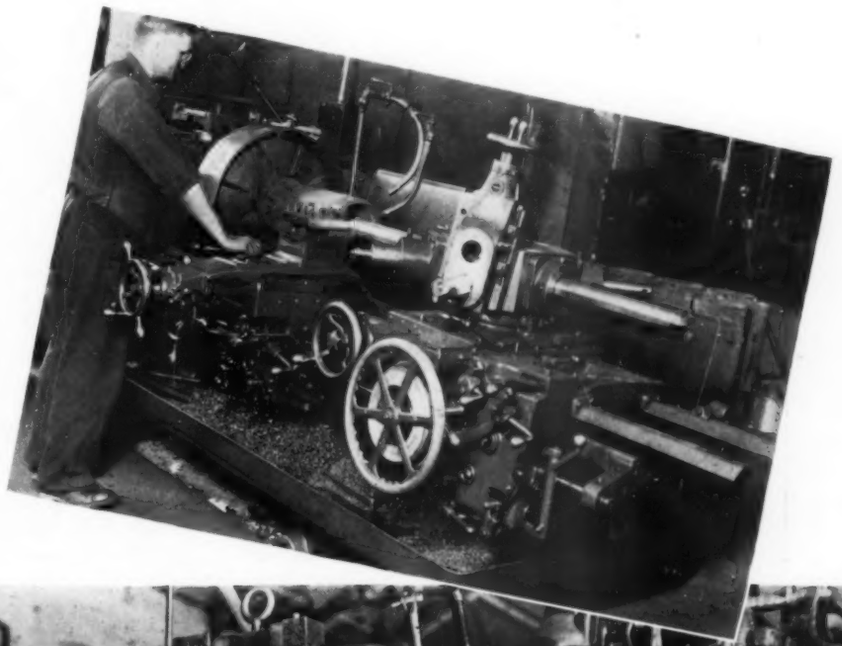
inspector, to assembly floor with a minimum of delay.

The cylinder liners are machined in this department. First operation is rough turning the outside to fit fixtures on the boring machine which eliminates practically all set-up time on this job. Details of the operations are given with the illustration. After boring these cylinders are honed to ±0.0005 in. and the outside is finish ground to +0.002 and —0.

Crankshafts are machined in a department devoted almost entirely to crankshaft operations. This department is equipped with the necessary large engine lathes, shaper, horizontal drill to perform the turning shaping and drilling operations on both forged and cast crankshafts. Lathes in which the cutters revolve have been found very suitable for turning and finishing the journals of the shafts. The fact that the tool and its holder revolves while the shaft is firmly held gives better results and accuracy than if the crankshaft were free to turn and thus bend out of shape.

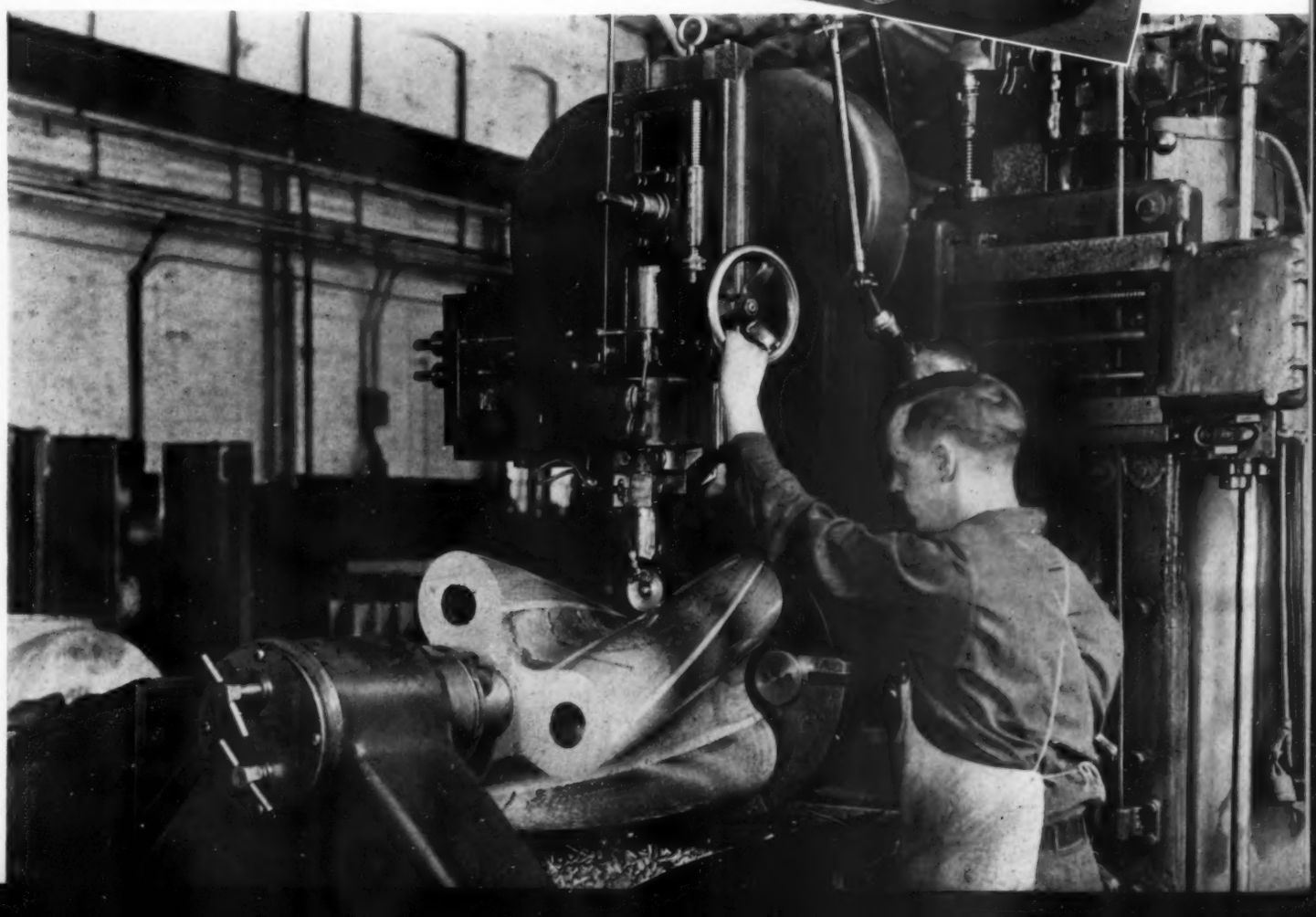
Precision parts such as the pump, needle bearing parts and connecting rod bolts (which require a No. 5 fit on threads) are machined in another department. Some idea of the precision work required is indicated by the fact that the pump must hold 5,000 lb. per sq.in. with no packing.

Spray tips are drilled in this room. Some of them have five 0.018 in. holes drilled through the sides of the cone-shaped end. Sensitive drills are used with an indexing fixture with an inclined axis. In general this shop is equipped with all-purpose rather than special design production tools, accuracy depending on quality of tools and fixtures with careful workmanship.



Some marine diesel liners are turned and bored on this turret lathe. They have a relief about 1 in. wide and 3/16 in. deep on the inside surface and the Fox type turret gives necessary traverse to cut this relief. This method of machining such liners is said to be five or six times faster than any other one tried

Aluminum impeller of blower is shaped using a special head and indexing jig. High speed tools are used to machine the lead to a tolerance of ±1 min.



Machine Guns in the Making

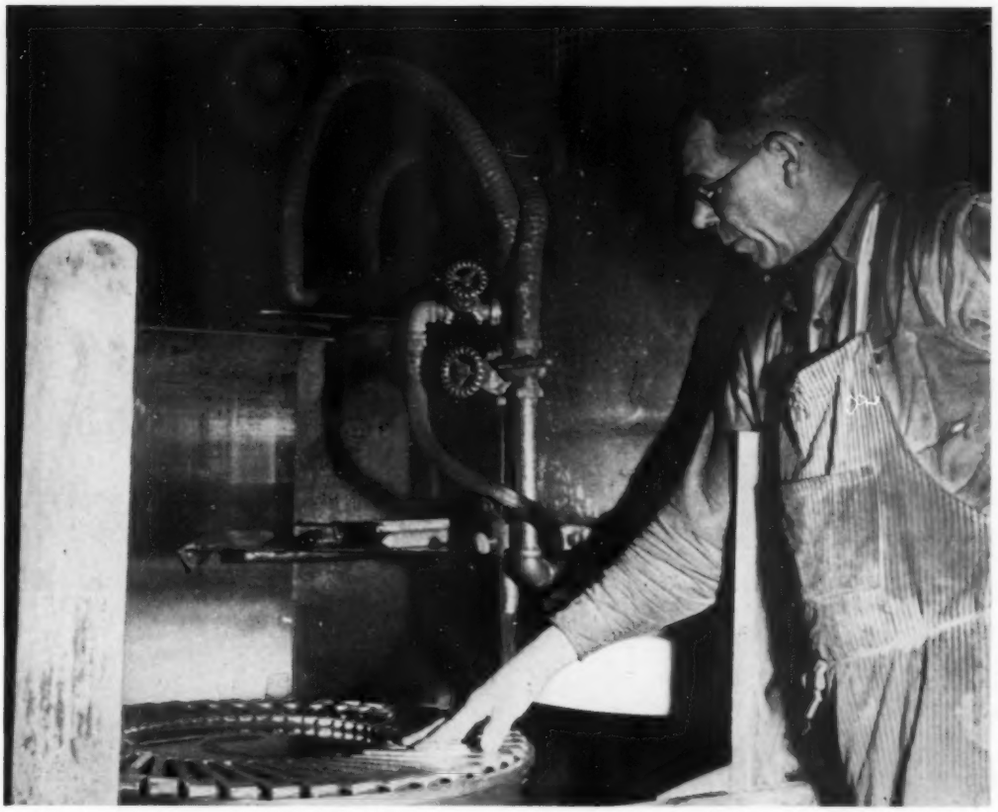
Colt's Patent Arms draws on a hundred years of past experience in applying automatic principles to gun design and manufacture

ON THE Brig Corlo, bound for India in 1830, Samuel Colt, then a boy of sixteen, conceived the idea for his world-renowned six-shooter. Watching the steering wheel of the ship he saw that each spoke came in line with a clutch that held it fast. That was what he needed to complete his invention. Unknown to young Colt, guns with revolving cylinders had been invented before, but these turned by hand whereas his revolved and locked automatically when his hammer was cocked.

Colt's story is in itself a romance. He overcame early setbacks and failures to put his business on a sound footing. In this his association with the military forces of the United States proved of great value.

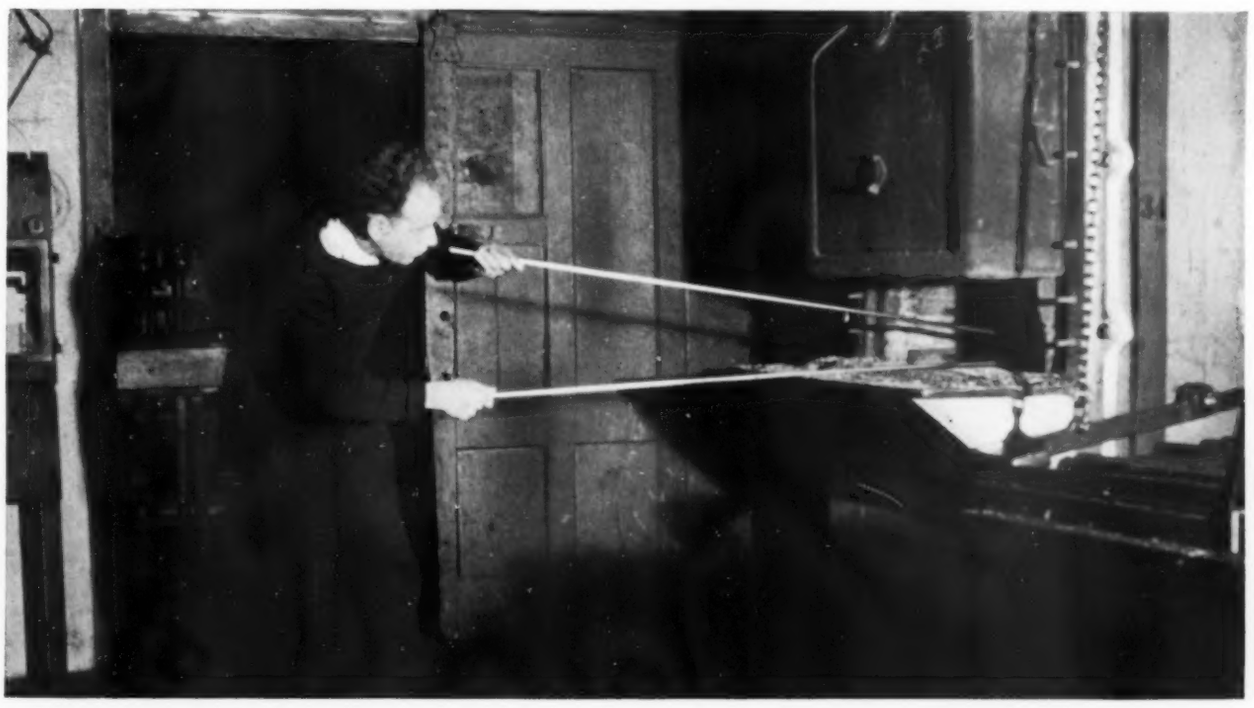
Colt had commenced manufacture in his first factory at Paterson, N. J. (1836), when the Seminole War started. The Seminoles would draw the fire of the troops, then swoop down on them before they had time to reload. Colt demonstrated the value of his weapons and secured orders for a considerable number.

Because of conflicting interests the Paterson plant failed, and Colt farmed his orders out to Eli Whitney who produced in his shop several famous revolver models, including the "Wells Fargo." Finally, in 1855, Colt again chartered his own company and built the world's largest armory at its present site in Hartford on the banks of the Connecticut River. Here he standardized production, designed machines for his purpose and created the modern industrial assembly line—this almost a generation before such methods were conceived by other industries.

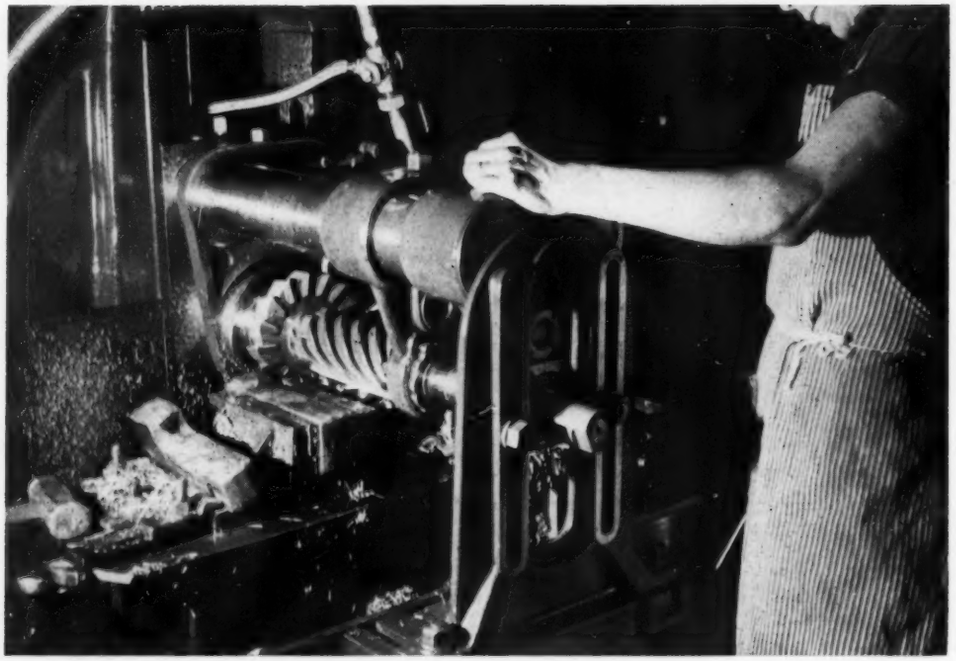


Side-plate brackets are surface ground in a Blanchard machine, using an electric chuck. This operation is typical, and machine capacity has been added for similar work on many machine gun parts on which fine finish is desired

Heat-treatment is an important phase of machine gun manufacture. In this modern electric furnace gun barrels are heated in the rough and rolled down an inclined side at the right into the oil quench



Barrels are taper turned in a new Hendey engine lathe using a copious flow of cutting oil. A good cutting speed is maintained despite the tough pretreated chrome-molybdenum steel used



Because of the number of cuts required on much of the work, cutters are frequently ganged for milling machine set-ups. The one illustrated shows a Milwaukee mill in use on barrel extensions

Colt died during the Civil War, but his organization carried on his work in the development of better firearms. It was natural then that Dr. Gatling should shortly after come to the Hartford factory with his famous gun which fired 1,000 shots a minute by means of ten barrels mounted around a central shaft. This invention was the grandfather of the modern machine gun and was produced up to the turn of the century.

Another renowned inventor, John Browning used the plant facilities to develop his single-barrel machine gun operated by gases formed by the burning powder. This weapon was first used by the U. S. Navy in the Philippines and shortly after it was adopted by the Army. Thousands of these guns were used by the Allies during the World War.

Today Colt supplies service revolvers, automatics and machine guns to both the Army and Navy. It furnishes small arms of many kinds to G-men, other branches of the federal government, and to the police departments of states and municipalities.

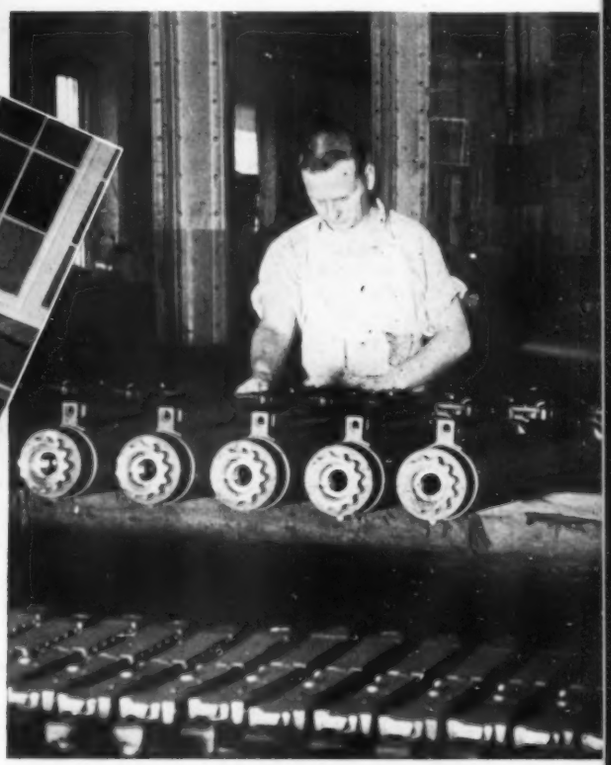
The company's whole tradition and experience make it an important unit in any program of national defense. Its men are trained in their specialized trades and take an honest pride in their product. Many have years of faithful service behind them, some exceeding the half century mark; 161 of them have been with Colt 25 years or more. The management is now constructing a pistol range which the employees can use during their noon hour—another indication that the company's product means a good deal more than a day's work to them.

Materials are important in firearms manufacture. Most parts are made of special steels; nearly all are heat-treated to specified degrees of hardness. If a machine gun barrel is to stand 10,000 rounds of rapid fire without losing its rifling grooves the steel must be right. For this particular application a chrome-molybdenum alloy is used. All incoming steel shipments are tested, both chemically and physically.

The heat-treating department is

After the parts have been heat-treated, machine gun frames are put together with the aid of a Townsend riveter. Holes have previously been line reamed

Parts are carefully checked by Army inspectors before being released for assembly; this is in addition to an independent inspection by company employees



Machine guns are mounted on special benches for final assembly. These are water-jacketed 0.50 caliber models

well equipped with gas and electrically fired furnaces, lead and cyanide pots, quenching and tempering baths. An adjoining test room contains Rockwell machines for checking the work of this department. Many of the parts must be hardened locally—the machine gun frame, for instance, is hard at the ends while the center section is relatively soft and tough.

Some parts pass through the heat-treating department several times. Drop forgings made at the plant from dies designed to give the required grain flow must be normalized before machining and heat-treated after going through the shop.

Both small arm and machine gun parts would be considered complicated in another industry. Because of the need for keeping the number of parts at a minimum one component is often used where another kind of mechanism would employ several. This peculiarity of design means irregular contours, recesses and other odd shapes that multiply the machining operations while giving simplicity in finished product. Certain parts, for this reason may have 50 or 60 steps performed on them before they are ready for assembly.

Despite the irregular shapes and many operations on some of the parts, each component of a small arm or machine gun must be fully interchangeable. This means that a part from one gun may be transferred to another in the field without any question of proper fit and that replacement parts shipped from the Colt plant a year or two later must drop into place and function accurately.

While machining, with a few exceptions, is performed on standard machine tools, special attention is given to tooling, gaging and fixtures. Milling is used extensively in profiling machines and in gang tool set-ups on knee-type milling machines. Because of the close limits called for and the wide use of heat-treatment, grinding plays an important part in the finishing operations.

Responsibility is centralized by assigning certain parts in certain departments. The parts are, for the

most part, too small and too varied to devote one department to a single component. An exception is the machine-gun barrel department which specializes on this work. Other departments work on a limited variety of small arm, or machine gun members, finishing these complete for assembly.

In assembly care is taken to have all edges smooth. Corners and sharp edges not removed in polishing operations are filed off prior to heat-treatment. Sub-assemblies, such as the machine gun frames are "blended," that is, the mating members are smoothed so they look like one piece.

Machine gun parts are Parkerized to a rustproof black, while automatics and revolver barrels are put into rotary furnaces with charred bone and primer to give them a beautiful blue finish.

The assembly itself is mostly hand work, with the parts going first into sub-assemblies, then into complete units.

Limits of accuracy are maintained by careful inspection. Each machine tool has its own check gages so the operator can measure his own performance. Then there are departmental inspections of parts and a final inspection prior to assembly.

The Army Ordnance Department has its own inspectors who recheck every finished part before it goes into the gun. In addition they test the assembled units for performance and precision.

The illustrations with this article show operations on the M2-50 machine gun, a 0.50 caliber weapon capable of firing 550 to 700 rounds per minute. The Army specifications on this gun call for a 100 per cent functional test. Each gun is fired five rounds with single ejection and 50 rounds staggered fire; 250 rounds rapid fire are then fired as a final test. The tests are made in inclosed booths in the Colt plant provided with a sand bank to stop the bullets.

In addition, ten per cent of the guns, selected by the Army inspectors, are given a range test which reflects their accuracy. A hundred rounds from an accurate gun will pass through a 4-in. circle with the target looking as though a few shots had been fired through it.

One out of every 100 machine guns is selected for a 10,000 round test. During the firing, repeated checks are made on the performance of the gun and the wear of its parts. After the test the gun is completely disassembled and reinspected.

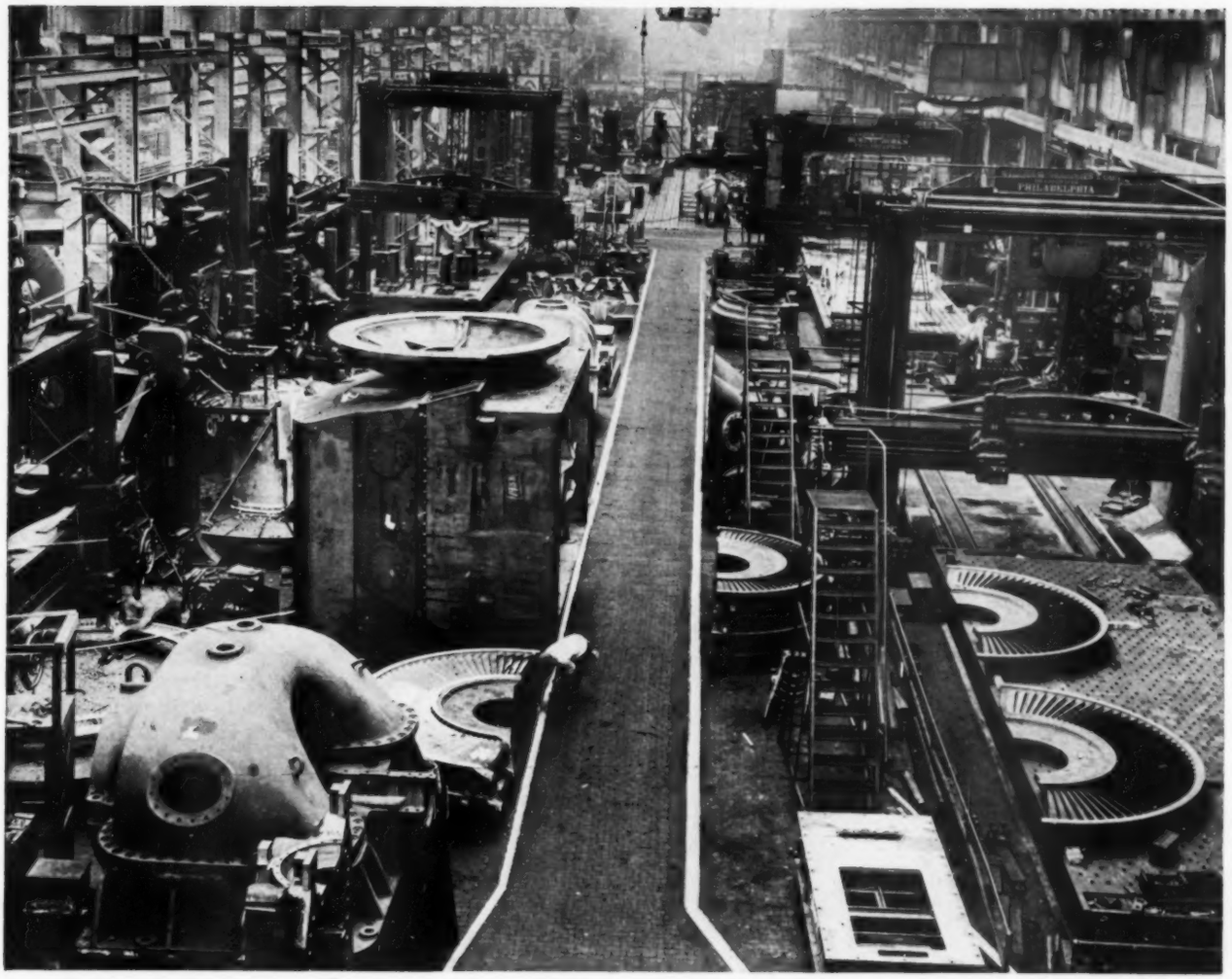
In this endurance test the Army inspectors cooperate with the Colt development department by permitting the use on certain guns of projected changes in design. Thus, contemplated changes are tried out in advance giving the designers a chance to prove the soundness of their ideas before putting them into production. Colt works closely with Army designers in developing improvements in its product.

Like many other plants, dating back over 100 years, Colt has its share of old equipment. During the last few years, however, the management has followed a progressive replacement policy and many departments have already been modernized.

Although Colt is associated with the manufacture of firearms in the public mind, this activity is only one of four branches of manufacture. In addition, the company makes electric switches, dish-washing machines and plastics. While these more recent products give desirable diversity to its operations and include many interesting manufacturing practices, they cannot compete in romance with the history of the firearms industry which down through the years has made Colt such a vital unit in our national defense.

Every gun is given a functional test, firing 255 rounds of ammunition. Bullets are stopped by a sand bank

Subassemblies are fitted at a bench after all rough edges have been filed off



One of two main bays in the turbine machine shop of General Electric Schenectady works, which is equipped to build 1,800,000 kw. of turbine equipment annually, including Navy orders

More Power to the Fleet

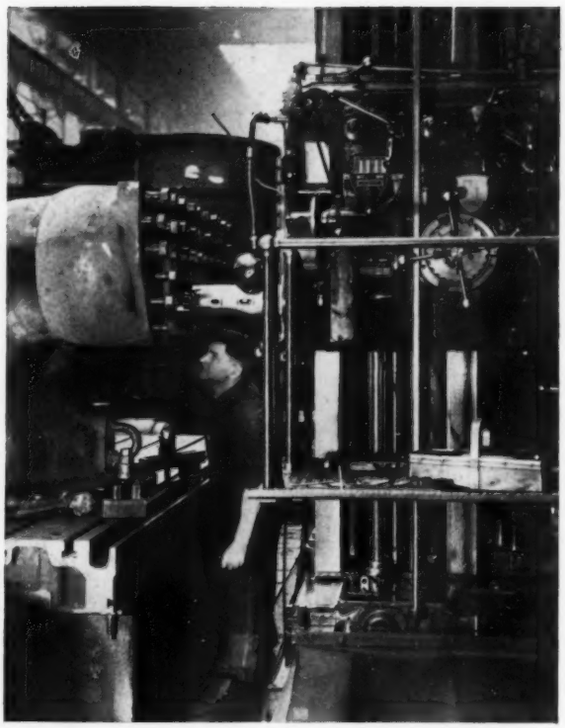
General Electric, a name long associated with power generation, turns its attention to turbines that breast the tides

IN AMERICAN naval history, the last twenty-five years have been unique in that great advances have been made in propulsion equipment. Reciprocating steam engines have disappeared in favor of turbine drives. The latter were at first direct-connected to propeller shafts, but because turbine efficiency is highest at high speeds and propeller efficiency is highest at comparatively low speeds, this arrangement gave way to turbine-electric and geared-turbine drives—the former consisting of turbines direct connected to generators which, in turn, are electrically connected to propulsion motors, and the latter consisting of compounded high-speed turbines driving single- or double-reduction gears connected to the propeller shafts.

Geared turbines operate between 3,000 and 10,000 r.p.m., with steam initially at 650 lb. per sq. in. pressure.

Space and weight savings effected by adaptation of gear-reduction drives and by modern turbines, which are smaller and more powerful than ever before, have definitely affected the fighting efficiency of modern warships; both fuel capacity and fuel economy have been increased, thereby increasing cruising radii; more armaments are carried; and heavier armor is installed. These are interdependent and proportioned according to the type of vessel and the service required of it as a naval fighting unit.

General Electric Company has been one of the pioneers in turbine



New machine equipment is the rule rather than the exception in the turbine machine shop. Here is a modern horizontal drilling, boring and milling machine boring integral valve fits in a turbine shell

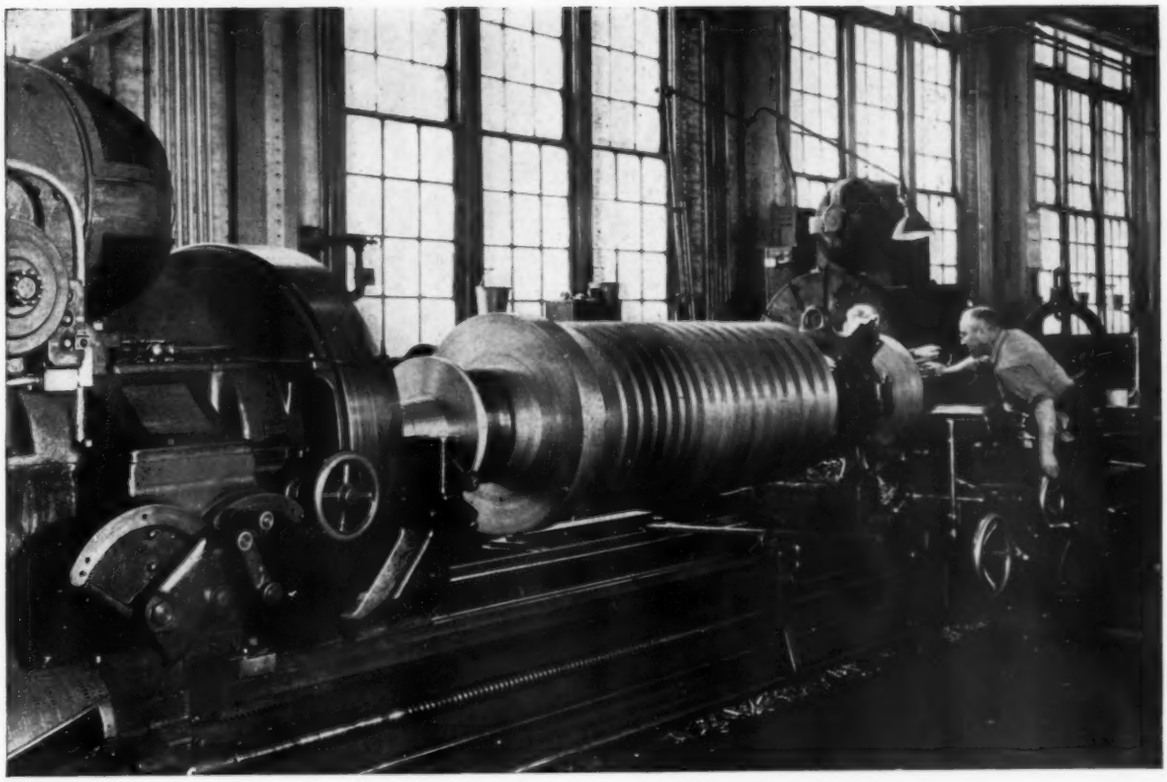
Low-pressure turbine casings, split on horizontal centers, are bolted together and bored for rotor clearance, diaphragms and packing casings on large vertical boring mills. After finish machining, the casings are subjected to a hydrostatic test at one and one-half times operating pressure

drives for naval vessels. In 1912 it installed the initial electric drive on the collier *Jupiter,* which was later rebuilt as the airplane carrier *Langley.* This was not only the first large ship to adopt electric propulsion, but it was also the first one to demonstrate the merits of the system under exacting service conditions. The adoption of turbine-electric drives by the U. S. Navy for its battleships followed quickly as the result of the successful installation on the *Jupiter.* The *New Mexico,* a quadruple-screw ship of 28,000 shaft horsepower was commissioned in 1918, and this was followed by the battleships *California, Maryland, Tennessee, Colorado,* and the *West Virginia* during the years 1921 and 1922. The airplane carriers *Saratoga* and *Lexington,* each rated at 180,000 shaft horsepower were completed in 1927.

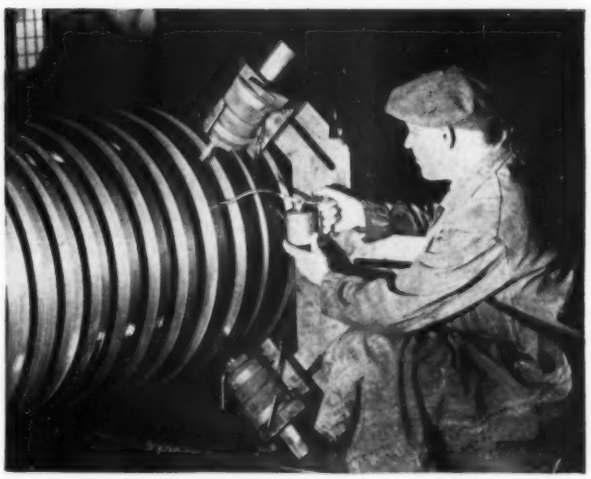
The Schenectady plant of General Electric Company is well adapted to the manufacture of marine propulsion equipment, being equipped to furnish 1,800,000 kw. of turbine-generators and marine-propulsion turbines per year. In addition, the River Works at Lynn, Mass. is equipped to manufacture turbine-generators and marine propulsion turbines in the amount of 420,000 kw. per year. Turbines and turbine-generators rated at 12,500 hp. or 10,000 kw. and above are manufactured at Schenectady, while units of smaller capacity are built at Lynn. Reduction gears for all units, both Schenectady sizes and Lynn sizes are built at Lynn.

Marine propulsion units of the type G.E. is now building for naval vessels, consist of a high-pressure and a low-pressure turbine, forming a cross compound unit, one such unit being connected to a double reduction gear. In some instances, especially for destroyers, an additional high-speed so-called cruising turbine is also used. The low-pressure turbine is designed to support the main condenser; however, the unit can be arranged for direct connection of a spring-supported condenser.

The turbines are of the impulse type in which the steam is fully expanded in the nozzles and not in the buckets. They consist of a number of bucket wheels integral with the shaft and inclosed in a casing. Diaphragms placed between the wheels divide the turbine into "stages" and provide nozzles to direct jets of steam into the buckets of each wheel. The marine-turbine casing is divided into two sections, split on horizontal centers. The rotors are of solid forgings with the wheels machined integral with the shaft. Shafts between



Rotors for marine turbines are machined with integral wheels from solid forgings. The wheels are dove-tailed and the journals are lapped after the rotor is heat-tested by revolving in an oven to determine deflections under temperatures equivalent to operation conditions



Rotor forgings are semi-finished and magnetically tested for cracks and slag inclusions. Magnetic poles are clamped at various positions on the rotors and an iron-bearing liquid, sprayed between the magnets, form individual magnetic fields at any existing flaws

the turbines and the gear reduction are joined by flexible couplings.

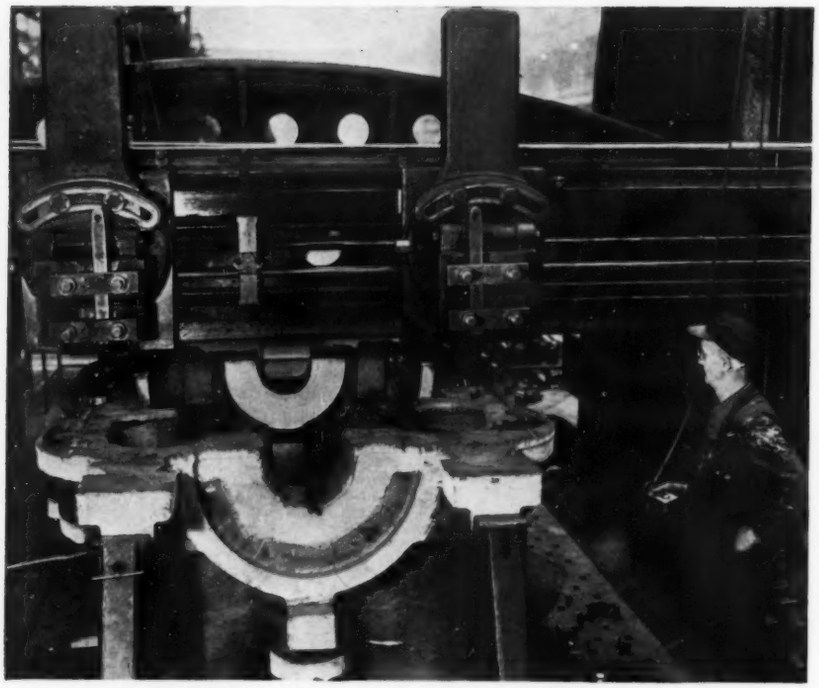
The main bearings of the turbines are babbitt lined, spherically seated, self-aligning, and pressure lubricated by oil. A thrust bearing maintains the correct axial spacing between the stationary and rotating parts, and compensates for the relatively small unbalanced thrust in an impulse-type turbine. As an additional precaution, the thrust bearing has "squealer rings" which rub and temporarily act as a thrust bearing to prevent damage to the rotating parts if the thrust bearing babbitt should wear unduly.

Maneuvering valves are provided for the ahead and astern turbines; in addition, a guard valve prevents cutting in the ahead units when the astern turbine is in use, or vice versa. The turbine governing mechanism throttles steam flow to prevent racing of the ship propeller in heavy seas. Speed adjusting valves regulate ship speed from 70 to 110 per cent. An emergency governor operates to close the valves should the speed exceed 115 per cent.

Gear reduction for marine-propulsion equipment is of the double helical type and consists of two high-speed pinions which are coupled to the high-pressure and low-pressure turbines each pinion driving a high-speed gear. The high-speed gears are connected to two low-speed pinions, which in turn drive the low-speed gear on the propeller shaft.

The casing inclosing the rotating elements is fabricated from steel plate. It retains the gear and pinion bearings in accurate alignment, and is divided into several sections to facilitate the removal, repair or inspection of the various gears and bearings. The joints between parts of the casings are made tight without the use of gaskets.

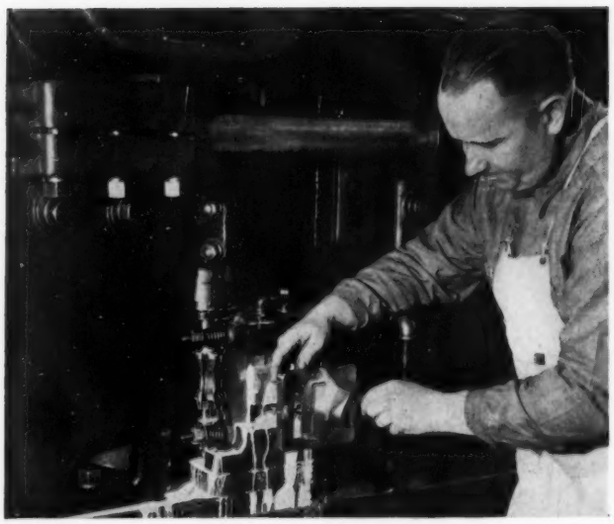
High-speed gears are of cast steel or of the cast-and-fabricated type. Low-speed gears are of fabricated construction, each consisting of a forged shaft with integral coupling, a cast-steel hub, conical web plates, and a forged rim in which the gear



The horizontal joints of high-pressure turbine casings are planed and mated for drilling and reaming holes for body binding bolts. After rough boring and facing the ends and flange fits, the halves are separated and chipped at places where defects of material have been located. Defects are welded and the casing is annealed

Stock for diaphragm partitions comes in rectangular or diamond-shaped rolled sections, and is milled to shape in four-spindle milling machines which finishes both sides of the stock in one pass through the machine. The operator is shown gaging a finished bar as it leaves the miller

Diaphragm partitions are rough ground, polished to 0.002-in. clearance and placed in spacing rings punched at required distances as here shown. The partitions are spot-welded in place preparatory to machining the rings to the width between diaphragm web and rim



teeth are cut. The pinions are solid with their shafts and made of carbon-steel forgings. All flexible couplings are of the high-speed type and are dynamically balanced. The bearings for the gears are straight seated, babbitt lined and pressure lubricated. The main thrust bearing is mounted in a housing on the forward end of the low-speed section of the gear casing. The lower part of the thrust housing is integral with the lower half of the gear casing and is arranged with footing for bolting to the ship structure.

Two large shops and part of a third at the G-E Schenectady works are tooled and equipped to repair, build and test all types of turbines. The largest of these buildings is 800 ft. long, 300 ft. wide, and consists of two main bays, four side bays, an annex and a gallery over each of the side bays. The second building is 940 ft. long and 199 ft. wide, while the third building is 800 ft. long and 135 ft. wide.

Both high-pressure and low-pressure marine turbines consist mainly of the casing, rotor complete with buckets, diaphragms between rotor wheels for reversing the path of the steam, valves and control equipment. Rotors with wheels machined integrally from solid forgings are finished in the second mentioned building which is equipped with 24 in. to 113 in. lathes for this purpose. Practically all the remaining turbine work is done in the larger building.

The main bays of this building contain all the larger machines, which are located on both sides of center aisles and served in each bay by two 100-ton cranes running above two 50-ton cranes. At the end of the bays is an 80,000 sq. ft. section fully equipped to make factory tests of turbines before shipment.

The small bays at the side of the building contain all of the smaller machines up to 100-in. boring mills. The following types of work are conducted there: boring, facing, turning and grooving of turbine wheels; magnetic testing of wheels and rotors; machining and press forming of diaphragm buckets; assembly of buckets to industrial and marine turbine wheels and rotors; and fabri-

cation of turbine lagging and piping. Machining of cast diaphragms and complete manufacture of built-up diaphragms, including annealing and welding, is done in the annex. One of the galleries is devoted to the manufacture of turbine blading, while the other is assigned the production of valves, control equipment, bolts, nuts, automatic screw-machine products, and all miscellaneous parts.

Casings for high-pressure turbines are cast, but those for low-pressure units are fabricated from steel plates and assembled by welding; both types are made in half sections and bolted together. The joint face of each unit half is machined in planers, 10 to 18 ft. between housings. Holes for binding bolts are drilled in the top half, which are then used in laying out the holes in the bottom section. The two halves are jointed and bored for diaphragms and steam packings. Holes for diaphragm locking plates are drilled, after which the entire casing is set on a 25-ft. boring mill to face the ends for support rings. The halves are then separated for milling diaphragm links, planing and drilling feet on the lower half, milling condenser connections, and drilling all steam-pipe and drain holes. Finally the halves are again jointed and finish bored. Previous to assembly of diaphragms the casing is subjected to a hydrostatic pressure test corresponding to one and one-half times normal operating pressure.

High-pressure casings are cast in the G.E. foundries at Schenectady; these are checked carefully for dimensions on reaching the machine shop. The horizontal joints of the half sections are machined and temporarily bolted together, following which the diaphragms and packing fits are rough bored; following this, the exhaust-casing flange fits are turned and the ends faced in a horizontal boring, drilling and milling machine. The halves are then separated, chipped at places where defects are obvious or X-ray inspection reveals defects. Chipped cavities are welded after pre-heating, and then the casing is annealed.

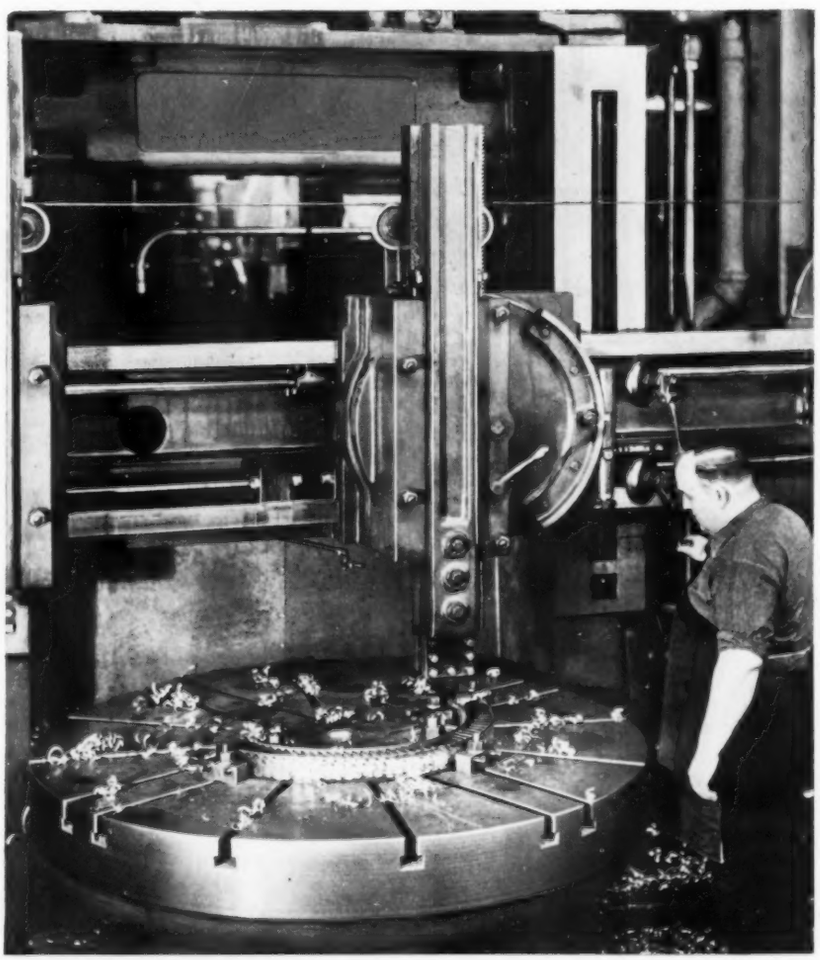
The joint faces are finish machined and the halves mated for drilling and reaming holes for the binding bolts. The bolted casing is taken to 12 or 14 ft. vertical mills where it is finish bored for rotor, diaphragm, packing and exhaust flange fits. It is unjointed for finish planing feet on the lower half, milling valve joints, and drilling all holes. Rings are inserted for supporting diaphragms and nozzles in the two velocity stages of the first pressure stage, which rings are required because the diameter of the casing at this point is considerably less than at other stages.

In general, stationary parts are the diaphragm supporting rings or intermediates for nozzles and diaphragms in the first pressure stage of high-pressure turbines, and nozzles, diaphragms and packing between the stages of both high- and low pressure units. The supporting rings are rough machined in boring mills from rolled semi-circular steel sections. When the joints have been machined, the intermediates are dove-tailed for buckets which are then assembled. Shrouding, attached to the bucket ends, is faced for clearance.

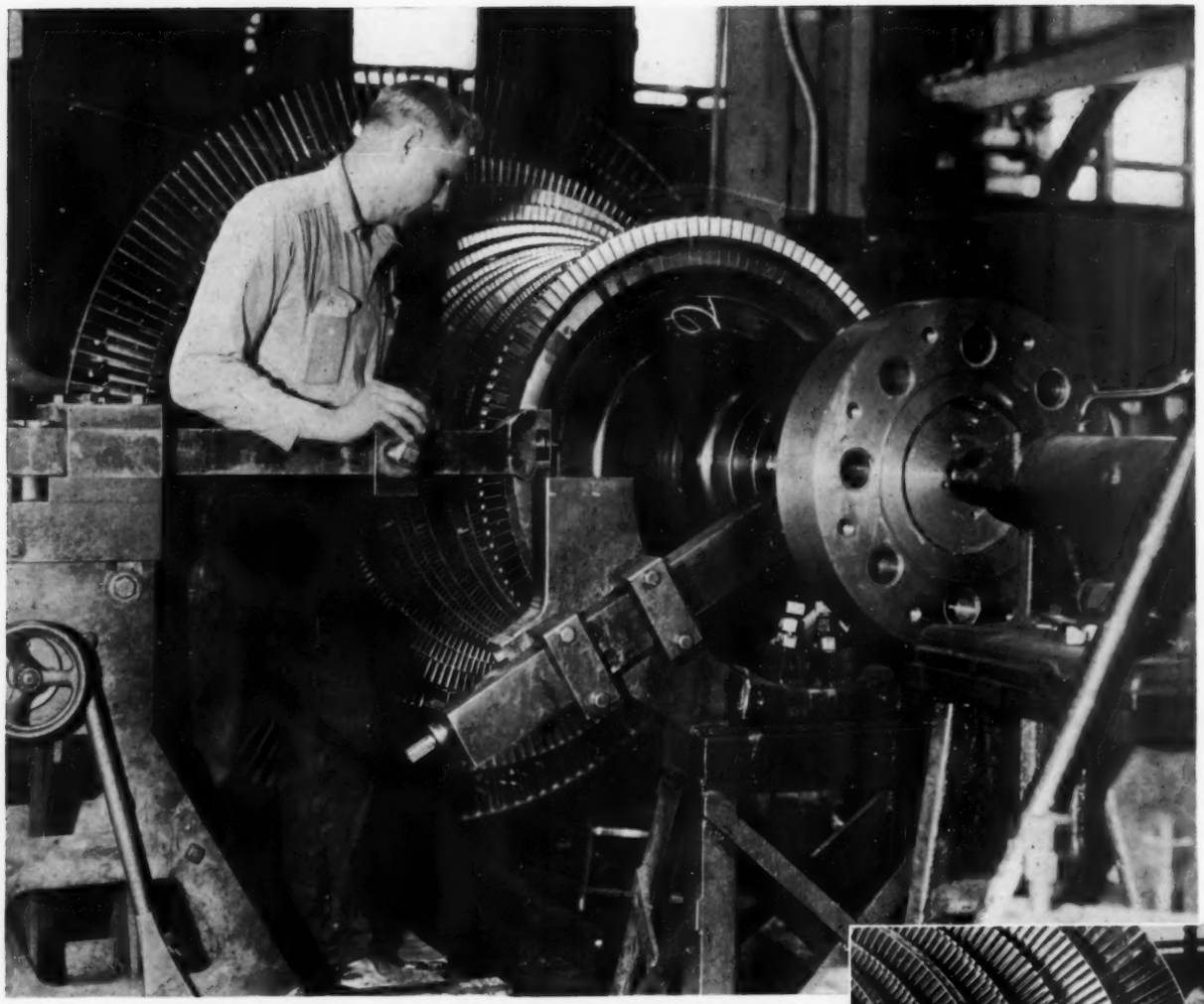
Diaphragms, which are rings holding stationary vanes for reversing steam between each two rotor wheels, are of the built-up type in high-pressure turbines, while those in low-pressure units are cast.

Stock for high-pressure diaphragm partitions comes in rectangular or V-shaped rolled sections, and is milled to shape in four-spindle milling machines with two pairs of cutters for finishing both sides of the stock in one pass through the machine. The stock is cut to required lengths, forming the partitions. These are rough ground and polished to plus or minus .003-in. tolerance. They are placed in spacing rings previously punched at specified distances and spot-welded in position. This spacing ring, or segment assembly, is first machined to a definite width, then the metal adjacent to each partition is closed with drift pin and hammer, and finally the partitions are welded solidly in place. Partitions for these diaphragms also may be of an integral side-wall type, which are assembled between the diaphragm web and ring in grooves dove-tailed in these two parts; this design eliminates the spacing-ring assembly.

The spacing ring assembly just



Half sections of diaphragm rings are faced on a boring mill to a width approximating that of the buckets. The ring metal is closed against the buckets, which are then welded solidly in place; the assembly is placed between a milled web plate and outside rim, and all three parts are welded, annealed and finish machined for assembly in the casing



Rotors, with integral wheels dove-tailed on their periphery, are mounted in centers for assembling turbine blades. The horizontal adjustable arm forces each blade into position against the assembled blades by turning the rotor

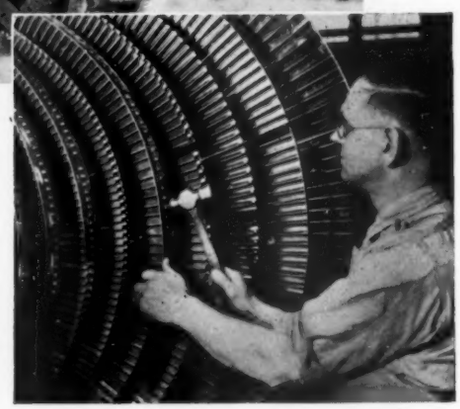
described is placed between a milled web plate and an outside ring, and all three parts are welded. After heat treating, the assembly is finish machined and the walls adjacent to the buckets are chipped and filed to provide smooth steam passage. The diaphragm is tested at 200 per cent load before assembling in the casing.

Partitions for low-pressure diaphragms are either milled as previously described or bent to shape hydraulically. These are sent to the foundry and cast integrally with the web and ring. The casting is finish machined for assembly in the casing.

Rotors for marine turbines are machined with integral wheels from purchased forgings which are heat-treated and tested before shipment to Schenectady. The forgings are semi-finished, magnetically tested for cracks and examined for defective material and slag inclusions. After finish machining, except dove-tailing for rotor-wheel buckets and lapping the journals, the rotor is heat-tested. In this test the rotor is held to deflection specifications while being revolved in an oven heated slowly to a temperature equivalent to that of steam under operating conditions. Deflection readings are taken at definite intervals from cold to hot and back to cold conditions.

Turbine blades or buckets are machined from bar stock of stainless steel. These consist of a dove-tailed end for assembly to rotor wheels and a so-called tenon end, which is the bucket proper.

The bar stock is cut to definite lengths, depending on bucket sizes, and ground on two sides to a thickness held within 0.0005-in. tolerance. These rectangular sections are stacked on their ground faces in a fixture, and the ends are milled. The sides of the metal and dove-tailed portions are then milled to shape and size in a turntable fixture which permits machining up to eighteen blades at one time; in the meantime, the operator is setting up eighteen additional blades at the opposite end of the table. Taper on the dove-tailed end is then milled to no tolerance.



Turbine blading is covered by shrouding, that is, metal strips accurately punched to fit over tenoned ends of the blades. The mechanic is peening the milled tenons to hold the shrouding in place

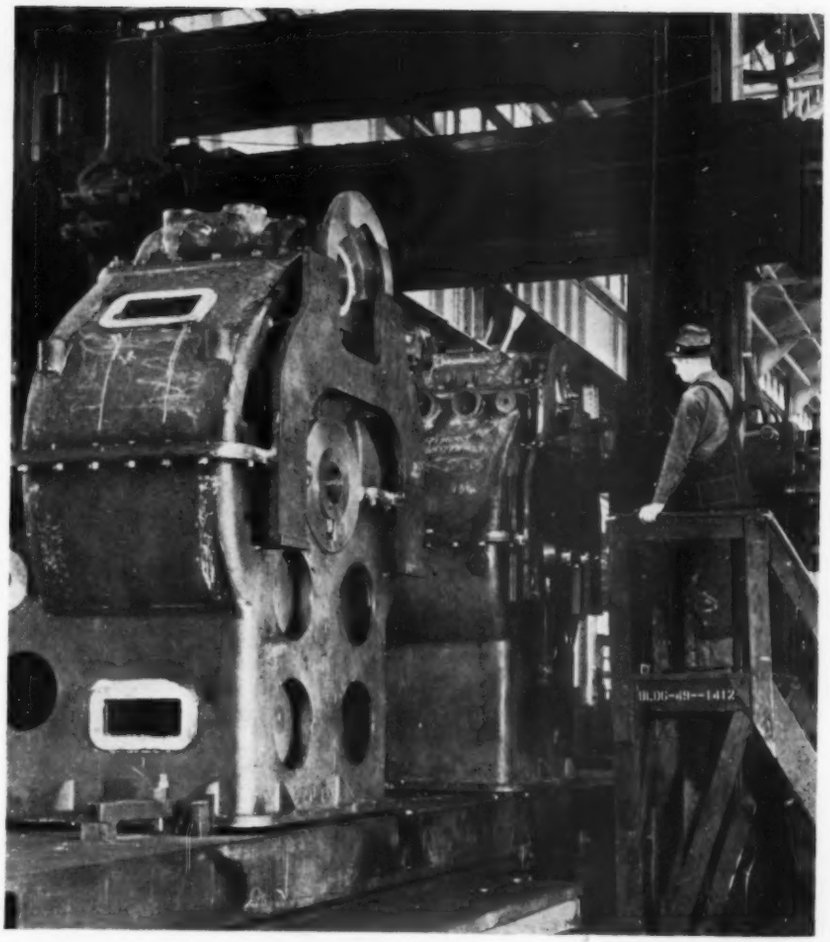
Following these operations on the dove-tailed end, the inside radius of the bucket is milled. The angle and radius on the outside of the blade are milled in either vertical or hori-

zontal millers. These feed and cut the exhaust angle on one end, throws in a circular feed which cuts the back radius, and then throws back to cut the exhaust angle on the other end. Between 0.003 and 0.005 in. of metal is left on the blade for polishing.

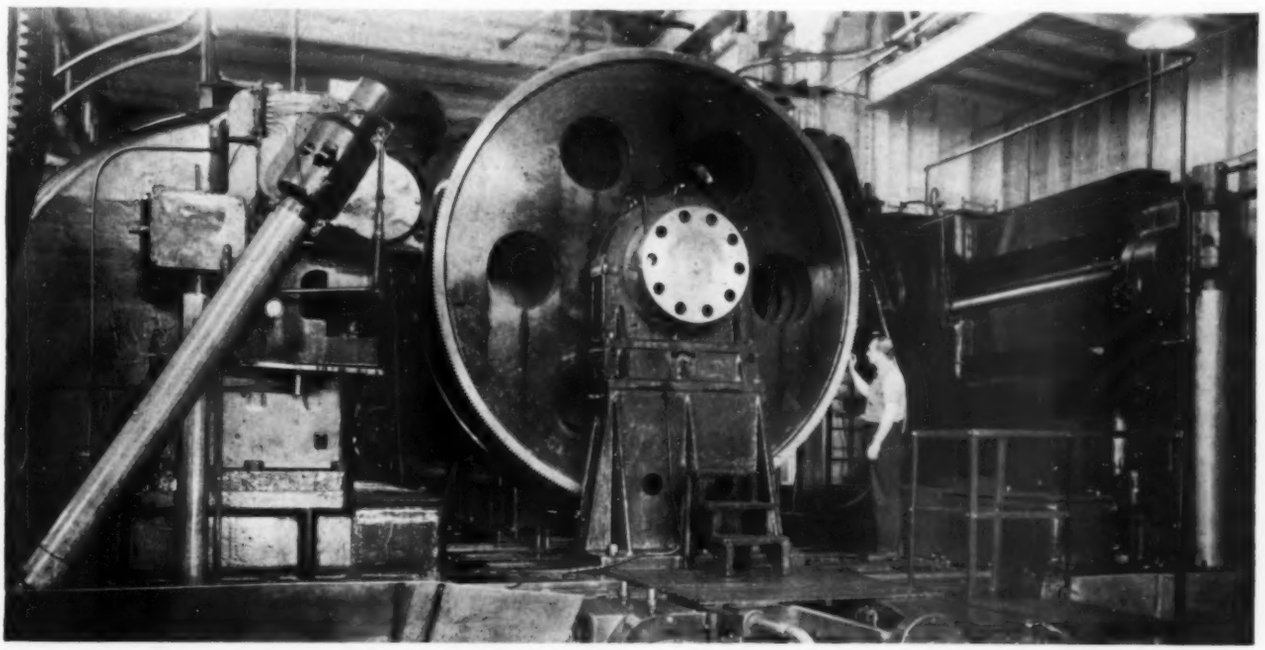
All dove-tailed fits between the buckets and rotor wheels, whether straight or curved to correspond to the arc of the wheels, are gaged to exclude light, the gages being checked to ± 0.00025 in. All the turbine blades are tested magnetically to detect flaws. The gages used in checking turbine parts are made in G.E. toolrooms and sent to a tool and gage service department for inspection and checking against standard gages. They are placed in tool cribs throughout the machine shop, and after use are returned to the tool and gage service department for checking before further use. All inspection and checking is done in air-conditioned rooms held at 68 F., ± 1 deg.

The rotors are mounted on centers and revolved by hand while the blades are inserted in the dove-tailed wheels; when all the blades are assembled, a locking piece holds them in place. Short sections of shrouding are placed on the tenon ends of the blade which are then peened. After the diaphragms and nozzles are assembled in the casings, the completed rotors are placed therein, packing between the stages is inserted, and the two halves of the casing bolted together.

All reduction gears for marine



Double-reduction gear casings, complete with bearings and lubrication facilities, are fabricated from flame-cut steel plate. One of the finished casings is shown on a planer for machining supporting brackets. All reduction gears for marine propulsion equipment are made at the G.E. plant in Lynn, Mass.



Large turbine-drive reduction gears are machined in this 164-in. hobbing machine at the General Electric plant in Lynn, Mass. These gears are fabricated from flame-cut conical web plates, forged hubs and heavy forged rims

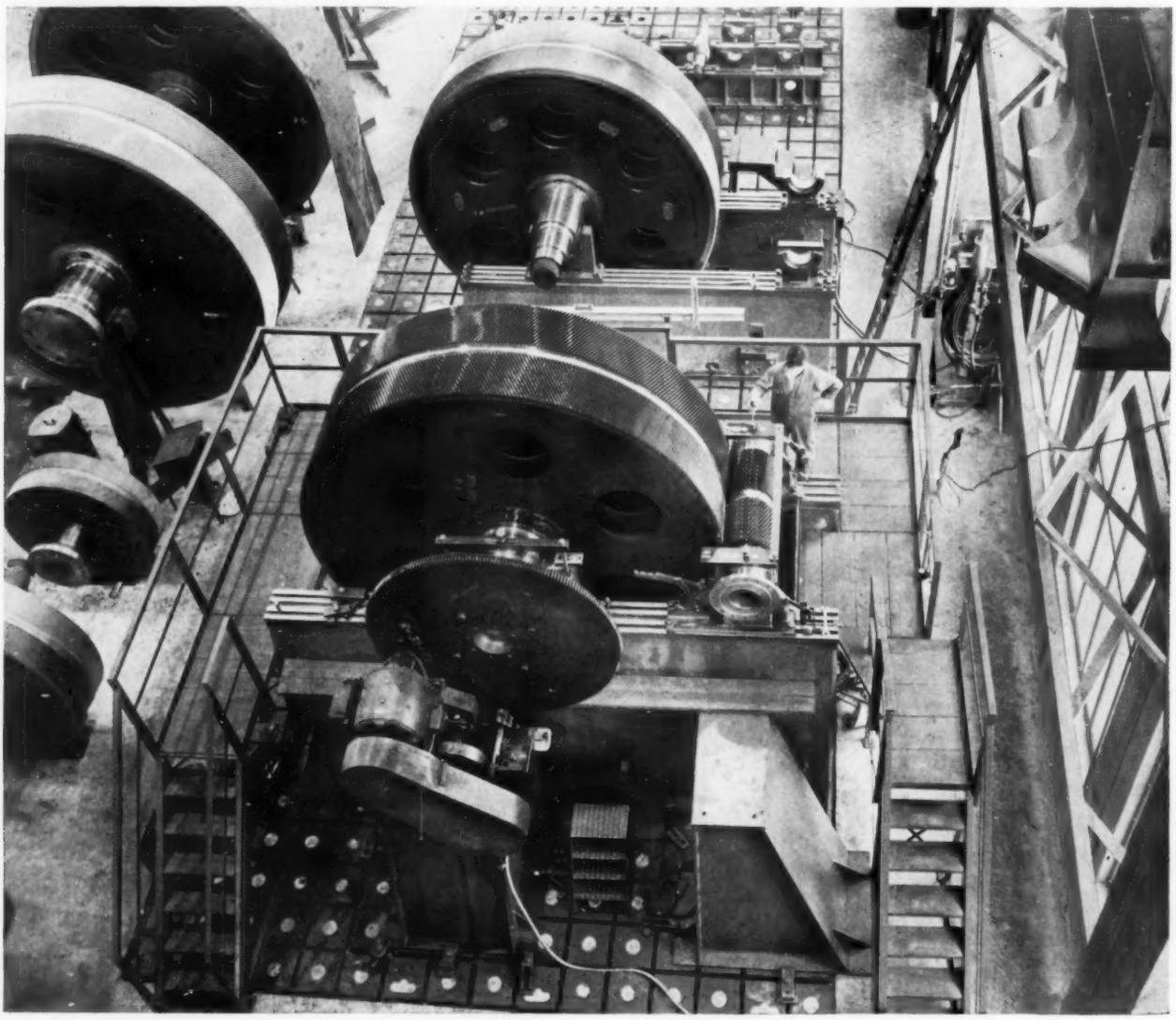
propulsion equipment are made at the G.E. plant in Lynn, Mass. Equipment for machining, balancing and checking these gears are located in a bay recently added to the gear cutting shop. This bay has a heating and temperature-control system which provides uniform temperature, thus avoiding contraction and expansion of the gears and gear hobbers during the cutting operations.

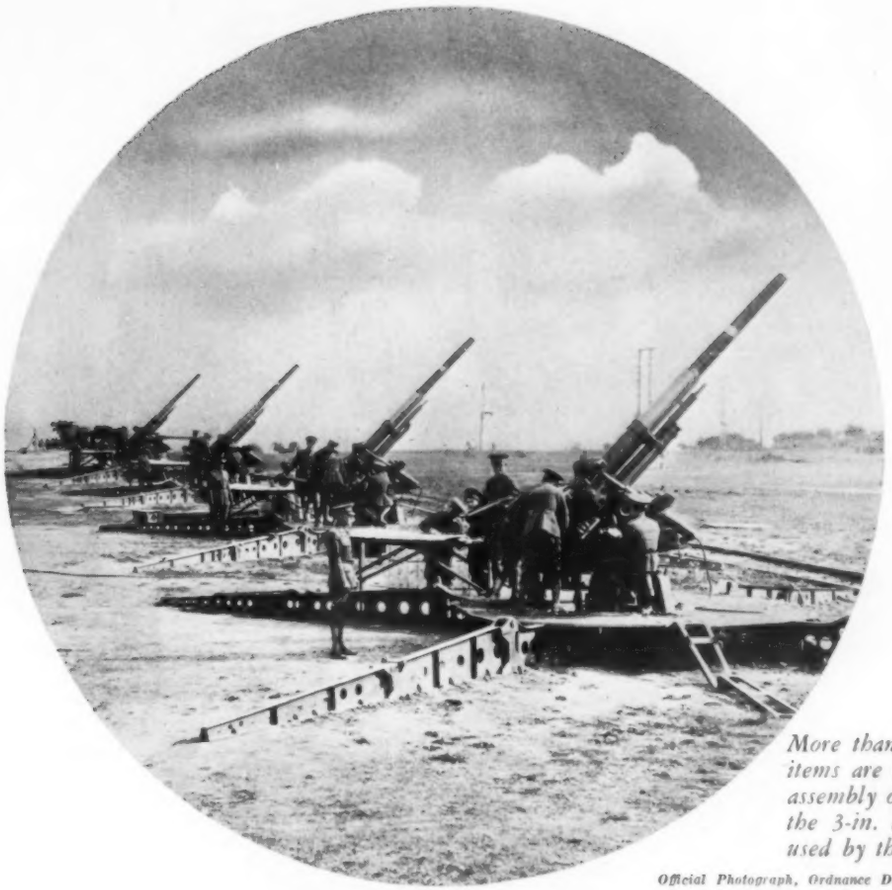
Large gears from 100 in. to 200 in. diameters, are of fabricated construction and assembled by welding. They consist essentially of flame-cut conical web plates, forged hubs, and heavy forged rims in which the teeth are cut. After welding, the structure is annealed, sand-blasted and thoroughly cleaned; dirt would be detrimental inasmuch as loose materials and weld splatter would ruin gear teeth under running conditions. The hub bore is finished, the outside rim diameter is roughed, and a machined shaft is pressed into the hub, after which the rim is finish machined concentric with the journals. It is then given a preliminary dynamic balance and goes to the gear hobber for the first or rough cutting. After rough cutting, the final dynamic balance is made and the gear is replaced on the hobber for the final and finish cut. The gear and its mating pinion, or pinions, as the case may be, are run-in as a check on the contacting surfaces.

After contacting, teeth spacings are pin checked, which method consists of inserting a round pin in each tooth as the gear rotates in its journal. This pin bears against an indicator bar mounted on the solid base of the test assembly, deflections of the bar being recorded by a dial gage set initially at zero. Variations in gage readings measure the difference in teeth spacing and gear eccentricity.

Gear casings are fabricated in sections from steel plates formed by oxyacetylene pantograph equipment. After the sections are assembled by welding, they are annealed, sand-blasted, and otherwise cleaned. Large planers or vertical boring mills are used for surfacing the joints. Holes for binding studs are drilled and tapped in large radial drill presses. Shaft holes are bored and faced in horizontal drilling, boring and milling machines operated by remote control which permit the operator to start and stop them from any location, either inside or outside of the casing. Finished casings are assembled and tested for leaks. After gears are inserted, they are tested under load before shipment to the purchaser.

Marine-propulsion reduction gears are contacted in this machine in the G.E. Lynn River Works. The room in which this and other large gear machines are located has a heating and temperature-control system which prevents expansion and contraction of the gears during machining, contacting and checking for teeth spacing and eccentricity





More than 1,000 different items are required for the assembly of the mount for the 3-in. anti-aircraft gun used by the U. S. Army

Official Photograph, Ordnance Department, U. S. Army

Welded Mounts for Air Defense

York Safe & Lock turns attention from security of cash and collateral to national security in the form of anti-aircraft guns

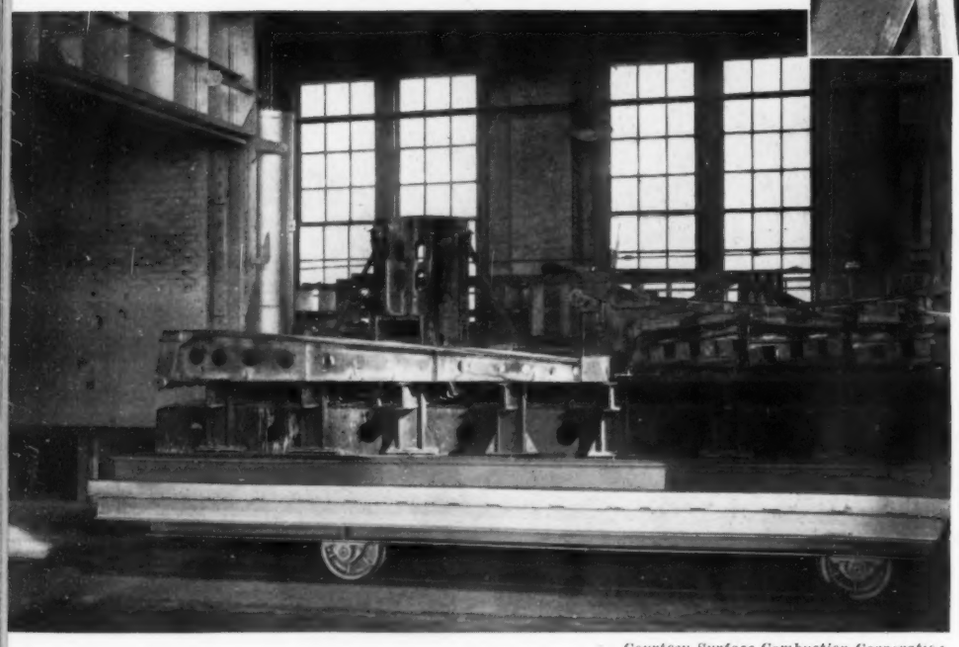
FOR THE first time since the World War, the War Department has awarded a major contract to a commercial plant for the manufacture of gun carriages. The York Safe and Lock Company of York, Pa., is now building a considerable number of 3-in. anti-aircraft gun carriages.

This contract illustrates the versatility of the American machine industry. In less than four months this contractor has built up from zero to a production basis a welding department employing more than thirty welders, turning out Class A welding which passes 100 per cent Magnaflux inspection and a relatively high random X-ray inspection. Machine tool equipment was likewise expanded and adapted to this work. Inspection facilities were enlarged and assembly facilities were created for the work.

Welding plays an important part in the manufacture of the carriages for the 3-in. anti-aircraft gun used by the U. S. Army. This has not always been the case. For a number of years no welding of any type was used in the production of guns and gun carriages by the Ordnance Department because of the heavy impact forces that these units must resist in service. It was only after a careful investigation of the problem of incorporating welded structures in gun carriages, and field tests of several sample mounts, that Ordnance engineers finally adopted welding as a permissible method for fabricating certain units.

All of the contractor's welders assigned to operations on the component parts for the mount are qualified according to tests specified by the Watertown Arsenal. These tests must be repeated annually. Any welder not qualified in the first test cannot repeat the test before one week has elapsed. His failure in the second test prevents any welder from repeating the test within three months. Each of the welding booths is equipped with a single-operator type welder and coated welding rods are used exclusively. Both motor-generator and transformer-type welders are employed.

The principal component assemblies for the gun carriages which are of welded construction include the pedestal and top carriage, the front and rear bogies, four main outriggers, four intermediate outriggers and four



Many of the welded components are of complicated design. These are assembled in special fixtures which locate the pieces for tack welding

Not only can defective welds be located, but the size and character of the defects can be determined by examination of the X-ray negative

The car-bottom stress-relieving furnace, through which all welded parts for the gun mount must pass, has capacity for 10,000 lb. of parts. Each cycle requires approximately 20–24 hr. in the furnace

Courtesy Surface Combustion Corporation

outer outriggers. Other smaller assemblies also are of welded construction. Components for these welded assemblies are cut and bent to shape and are assembled in fixtures for tack welding. Not only do these fixtures reduce welding set-up time considerably, but they locate and assure alignment of the component parts of the assembly. The major units all are assembled in fixtures developed especially for this purpose.

Welding specifications call for all structures to be positioned so that welds can be made in a flat or horizontal position. This necessitates the use of universal welding positioners, of which a number are installed in the booths devoted to final welding operations. It is necessary only for the operator to press a button to bring the table of one of these units into position for any given weld. Most of the welds are laid in one pass, in order to obviate difficulties frequently encountered when laying one bead on top of another.

In the design of all of these assemblies, the welds are placed at points where stresses are low. For instance, the main arms of the top carriage are made of one piece and bent to shape before welding. It is the Ordnance Department's practice to avoid welds at point of maximum stress wherever possible, even though sufficient test data have been accumulated to show that properly made welds have almost the same strength as uncut plate.

The top carriage, which supports the gun and recoil mechanism, takes the direct shock of the discharge of the gun and so must be designed with high factors of safety in order to maintain accuracy of fire. Originally made as a one-piece steel casting with the lower stem integral, this unit now is assembled from shaped pieces of $\frac{1}{4}$-in. thick low-alloy steel with the advantage of weight saving without loss of strength. Likewise, the pedestal is made from assembled sections of formed steel plates, the the sides being $\frac{5}{32}$-in. thick, while $\frac{1}{4}$ and $\frac{1}{2}$ in. plates are used at other points. Each of the outrigger sections, which fold together to form the trailer body when in the traveling position, are made from varying thicknesses of plate.

Complicated components usually are built up by welding together subassemblies into units and gradually joining these sub-assemblies together to form the complete structure. In the case of the top carriage, the skirt

Welding specifications require that all structures be positioned so that welds can be made in a horizontal position. Since the assemblies are of irregular shape, they are moved to positioning tables for final welding

and the main horizontal plate form one sub-assembly, while the yoke, ribs and flanges form another. These two units then are welded together before the seamless tube stem, which forms the third sub-assembly, is welded into place.

Both the method of applying the weld and the distribution of the weld is important. These factors have been worked out carefully by the Ordnance Department designers and are included in the specifications to which the York Safe & Lock Company works. A heavy-duty X-ray unit was installed especially for this contract and is set up in a lead shielded room near the welding section. A complete dark room with solution tanks and film driers is adjacent to the X-ray room. Here, the inspector in charge of this activity can expose the necessary negatives, develop them and then place them on a viewing screen with very little elapsed time. All welded assemblies for the gun mount are delivered to the X-ray inspection room where certain specified welds are inspected on each unit.

Because of the nature of the assemblies that must be inspected by X-ray, the X-ray tube head is suspended from a jib crane arm and is arranged so that it can be swung into any desired position for making the necessary exposures. The exposed and developed X-ray film of a given weld not only will show any defects, but make it possible to determine their size and character. By studying negatives of welds it is possible for the welding operators to develop improved technique and so raise the general level of weld quality.

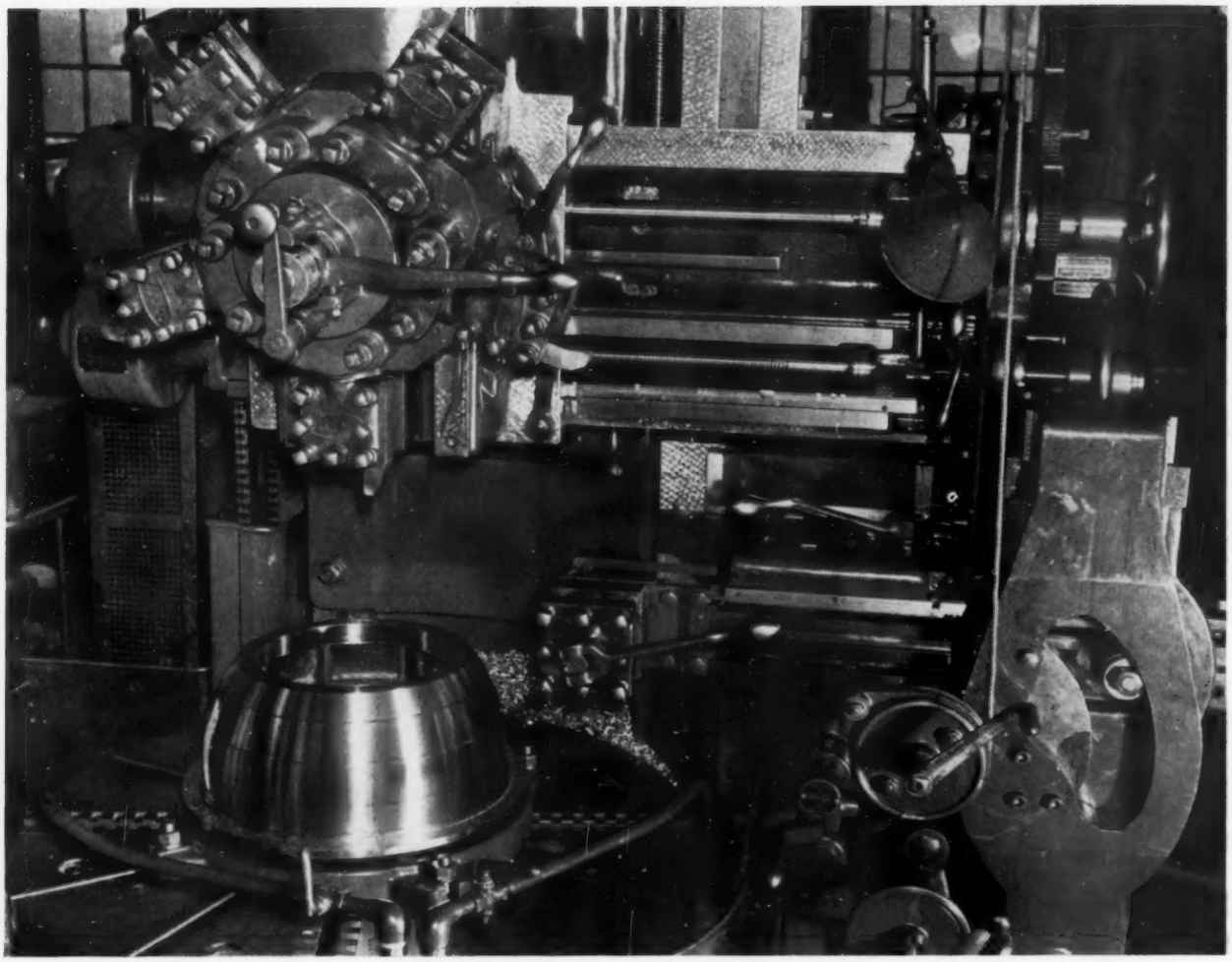
Following X-ray inspection, all welded assemblies are annealed to relieve internal stresses. This is done in a car-bottom type furnace. The car of this particular furnace has capacity for a load of 10,000 lb., and the furnace is capable of heating 5,000 lb. of steel per hour to 1,120 F.

The furnace is heated by recirculated air supplied by a gas-fired air heater located at the rear of the furnace. The heated air is forced by means of a fan into the furnace and through the work on the car. After giving up a portion of its heat to the work being annealed, the air is recirculated through the heater. This form of heating is very efficient and results in uniform temperature throughout the furnace.

After being brought up to the annealing temperature, the load is held at this temperature for several hours to permit thorough soaking. Then the parts are allowed to cool slowly in the furnace to a temperature of not more than 390 F. before removal. The complete cycle for a furnace load during the annealing operation averages 20–24 hr. A bank of recording pyrometers with thermocouples at sixteen positions check the furnace temperature during the entire cycle. These pyrometers, together with other control instruments, are mounted on a panelboard adjacent to the furnace.

Some of the assemblies are sent to the machine shop for intermediate machining operations, and then returned to the weld shop for joining with other units to form a complete component. Such components then must go through the X-ray and annealing cycles before final machining. Since there is, of course, some movement of sections of individual parts during the annealing operation, all welded components are delivered to a layout group where it is determined whether the surfaces of each individual part will clean-up during the machining operations. If not, these units must be straightened and reannealed before machining. The specifications under which this work is done limit the amount of such straightening, as it is essential that all parts be kept at a high strength value.

More than 6,000 pieces are used in the assembly of the anti-aircraft gun mount. While the major units are of welded construction, many of the other items are made from castings, usually of aluminum alloy or forgings. Others are made from bar stock. Because of the need for interchangeability and requirements that the gun be capable of accurate fire, accuracy of manufacture is of prime



Accuracy of machining is essential in the manufacture of this spherically-shaped bronze bearing which later is mounted on the spindle of the top carriage to permit leveling the gun

importance. For this reason, jigs and fixtures are use extensively, both in the welding shop and in the machine shop. These have been developed especially for this job and most of them were made in the toolroom at the plant. One of the principal advantages of making these tools of welded construction is that it permits their manufacture in a shorter time than if patterns and castings have to be made specially.

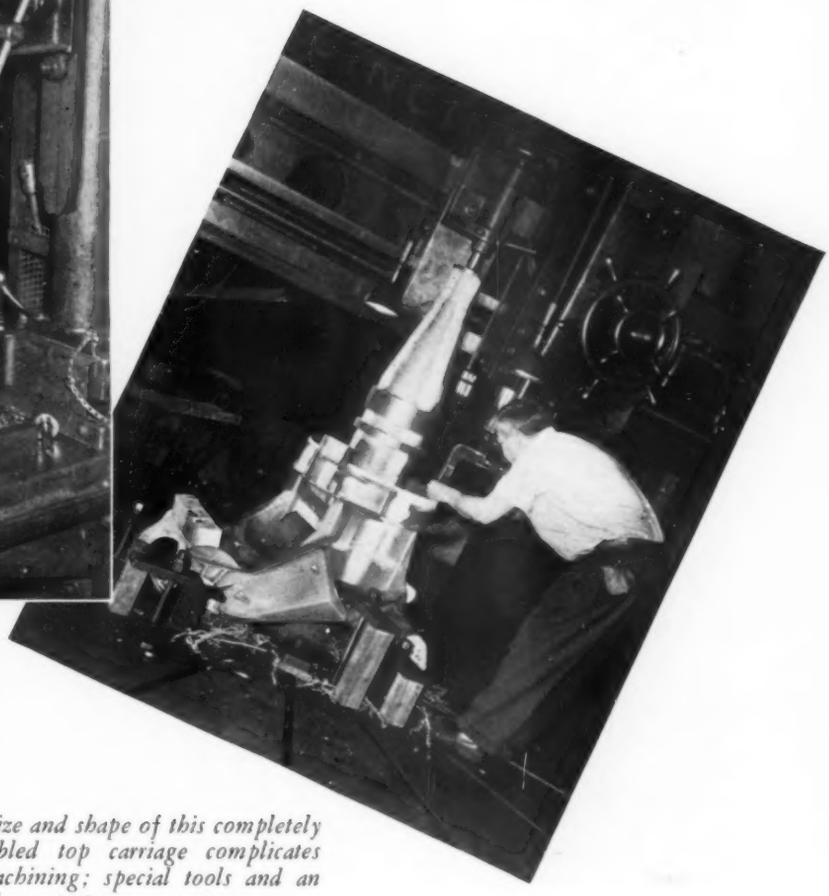
The top carriage is connected to the pedestal by means of an ingenious spherical joint which permits the carriage to be cross leveled. The production of this joint involves a number of interesting operations. Primarily, it consists of a spherical bronze bearing which fits in a steel bowl mounted in the top of the pedestal. This bearing carries the main gear which traverses the gun around the vertical axis. Both a special spherical turning and a spherical boring attachment are mounted on a standard vertical boring mill for turning the bronze ball and boring the steel seat for the spherical joint. These two units are held to close limits of accuracy, as there must be no looseness in this joint, and they are lapped together in an improvised motor-driven lapping machine.

Capable of measuring angles with a precision greater than 1/6400 of a circle (one artillery mill) in elevation or horizontal direction, this gun carriage presents problems of assembly not ordinarily found in units that must bear the shock loads to which the mount will be subjected. Precision anti-friction bearings are used for most of the moving parts and these, together with the control gear, are protected against mechanical injury and the entrance of any abrasive material which eventually would cause wear and develop inaccuracies. No backlash or shake can be permitted in any part of the assembly.

Hence, all of the component parts, are carefully inspected to insure that their dimensions are within established tolerances. Following inspection, these units are delivered to a stockroom for storage until required on the assembly floor. Most of the larger units are scheduled for manufacture as required and so are delivered directly to the assembly floor following inspection. Other large units purchased on the outside, such as the axle, wheel and brake assemblies, are stored in the plant and delivered to the assembly floor as they are required. The smaller components are delivered by lift truck in specially developed racks which have adjustable wooden shelves and partions which can be arranged to suit the size of the individual parts and serve to protect them during transit. Theses racks are placed near the assembly positions so that the workmen will have the needed parts conveniently at hand.

In the assembly of these mounts, first the pedestal is placed on an assembly support, of which a number are placed in line down the assembly floor, and then the various components are mounted in position on the

The steel traversing gear and spherical bronze leveling bearing are sub-assembled before mounting on the spindle of the top carriage. Holes for the twelve bolts are drilled and reamed simultaneously in both pieces



The size and shape of this completely assembled top carriage complicates its machining; special tools and an ingenius set-up are necessary

All welded components are delivered to a layout table immediately after stress-relieving. Three reflectors fitted with fluorescent light tubes illuminate this table

pedestal. The four main outriggers are secured to the pedestal by means of heavy vertical pins, which permit the outriggers to swing in a horizontal plane. They can be folded together to form the trailer body, or opened to form radial support arms when the gun is in firing position. The intermediate and outrigger units are attached to the main outriggers, and the other components are assembled to the pedestal.

During the main assembly operation there are a number of items that must be fitted together carefully, for this reason work benches are placed along one side of the assembly floor, convenient to the assembly positions. A number of component sub-assemblies also are built at these benches.

During the assembly operations, all sharp edges are removed from holes, and the first and last thread on shafts and plugs are filed to remove the thin end. All fins and burrs are removed from gear cases before assembling and after preliminary fitting of the gear cases they are completely disassembled and all parts are cleaned in a solvent. The inside of the gear case then is shellacked before final assembly. Ball bearing seats are scraped to fit so that ball bearings can be tapped lightly into place. Seats for thrust bearings are scraped to insure flatness.

For checking the spherical surface of this bronze bearing a standard dial gage has been mounted in a pivoted arm of a specially designed inspection fixture

Sixteen holes are drilled from a jig in this operation on the pedestal. These holes later are tapped with the same radial drill press

Each welded component is carefully inspected after machining to insure interchangeability with mating parts

Brass Buttons to Shell Cases

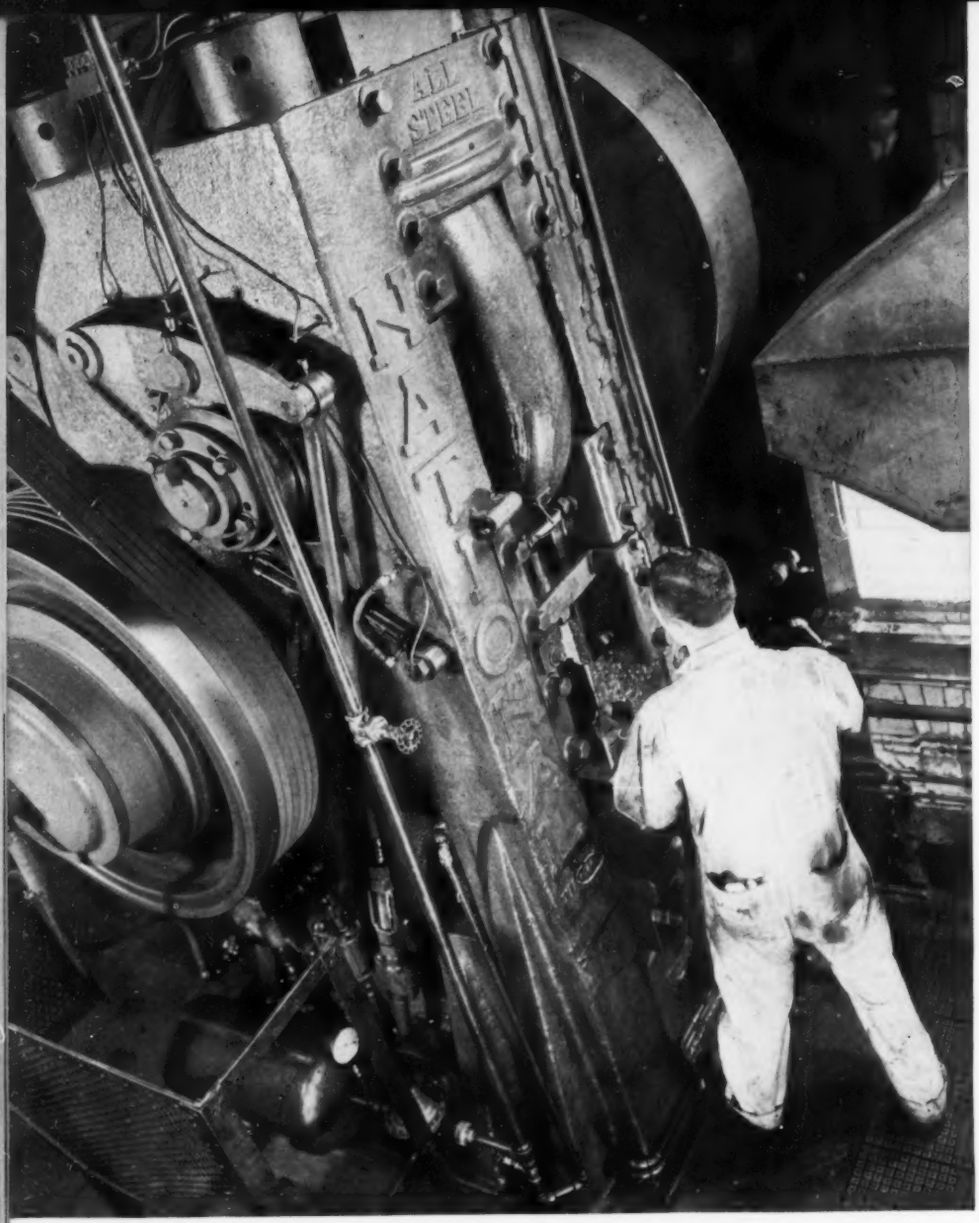
Scovill's mixing of war and peacetime products keeps its plants in stand-by position as a potent source of munitions

THE Scovill Manufacturing Company, Waterbury, Conn., is one of the country's leading producers of metal products. Now manufacturing over 300,000 different items for commercial use with facilities expanded rapidly during and since the World War, the Scovill plant could be turned quickly into one of this country's largest munitions factories. Its casting shop and rolling mills produce slab stock and billets from alloys of copper, zinc, lead, tin and nickel. There are hundreds of stamping, forming and finishing machines which could soon be arranged and tooled, if the need should ever arise, to furnish vast quantities of war materials. Today, sections of the plant are organized for the manufacture of 75-mm. shell cases. Also, cups for 30, 45 and 50 caliber rifle, pistol and machine gun cartridge cases are in regular production.

Scovill's history and rapid growth is the result of war-time activities and the application of its plant facilities to the production of thousands of miscellaneous items for public consumption during peacetime. Its establishment dates back to 1802 when one Abel Porter of Waterbury and three other rock-ribbed New Englanders drew up articles of partnership and proposed to make buttons—brass buttons. Their raw materials were worn-out copper stills and kettles, plus zinc imported from England. James M. L. Scovill joined the company in 1811 and under his leadership these pioneer button manufacturers flourished. By 1834 the company was making rolled brass, wire and a number of articles such as lamps, coins and household utensils. After Daguerre's invention of photography in France, the company was one of the first in this country to become engaged in the production of silver-coated copper plates and camera parts.

During the last half of the nine-

Typical of modern machines in the Scovill plant is this five-spindle drilling, tapping, reaming and counterboring automatic. Doubled in size since the World War, this plant today produces over 300,000 articles for commercial use and could be converted into one of the country's largest munitions factories



One of the large presses in the Scovill plant used in regular production of commercial articles. This and hundreds of other stamping, forming and finishing machines could be tooled quickly to furnish war material

teenth century, Scovill history reflected the meteoric growth of all American industry. The company began to manufacture munitions immediately after the start of the Spanish-American War—Brass cartridge shells for rifles, parts for crude time fuses, cupro-nickel bullet jackets, loaded shrapnel shells and metal uniform gear. But this was only practice.

In 1914, the warring European countries cried for millions of tons of munitions. After the United States entered the war, all Scovill's commercial activity was dropped and the entire plant turned into a munitions factory, practically commandeered by the government. Capacity was increased fabulously to meet demands. The 4,200 employees in 1914 increased to 15,000 in 1918. Plant investment jumped from less than four to nine million dollars. A tally of actual wartime production runs into fantastic figures: Two billion brass cups for cartridge shells. More than 443 million bullet jackets. Over 21 million assembled time and combination fuses for shrapnel. The number of 75-mm. cartridge cases exceeded 19½ million. Billions of varied pieces for armament needs were also made, including belt and cartridge clips, uniform buttons, bandoleer-belt fasteners, and rifle cleaning rods.

Then the war ended. Overnight Scovill ceased activities—its enormous plant and thousands of experienced workers stood idle. A market had to be found in the commercial world for the plant's productive capacities. Not only was this done, but so many products were developed that the plant expanded through the 1920's and 1930's until today it includes 200 buildings, encompassing 4,500,000 sq. ft. of floor space, and has over $20,000,000 invested in modern types of metal-working equipment.

The plant of the Scovill Manufacturing Company is laid out in the shape of a huge C in the very heart of Waterbury, Conn. It is organized into six main divisions. The mill products division turns out sheet metal for forming and stamping; rod of all shapes for automatic screw-machine products; tubing for plumbing purposes; wire in round, flat and special shapes; and condenser tubes. Only half of this division's production feeds Scovill machines, the other half being sold to other concerns.

The second division of the company manufacturers to order practically anything made of base metal, from a single part to a completely assembled product. There are complete facilities for drawing, stamping, forging, casting and finishing the innumerous articles.

The merchandise division manufactures and keeps in stock a line of miscellaneous metal products for wholesale and retail distribution. These include lamps, flashlights, ash trays, desk sets, sprinklers, hose equipment, etc.

One of the oldest divisions is that for producing buttons and fasteners for uniforms, work clothes and dress clothes. These are made in every known design, while every year hundreds of special designs are turned out of the mills.

Another division is devoted to the production of all types of cap screws, machine screws and screw-machine products of steel and non-ferrous metals.

The sixth division produces medical, drug and toilet articles such as vanity cases, talcum powder cans, bottle caps, jar covers, etc.

In addition to these divisions of the company proper there are five subsidiaries. The Waterville Division at Waterville, Conn., manufactures brass plumbing fixtures. A. Schrader's Son, Brooklyn, N. Y., produces valves and valve accessories for pneumatic tires, as well as air-pressure equipment such as air chucks, tank connections, diving apparatus, etc. The Oakvill Division, Waterbury, Conn., makes notions, office supplies and miscellaneous wire and sheet metal products; included are such items as safety pins, thimbles, thumb tacks, clothes fasteners, badge-makers' supplies, etc. The fourth subsidiary is the Morency-Van Buren Division of Sturgis, Mich., which manufactures closet tank fittings such as ballcocks, flushing levers and seat hinges. The last division is the Hamilton Beach Company, Racine, Wis., which produces electric appliances,

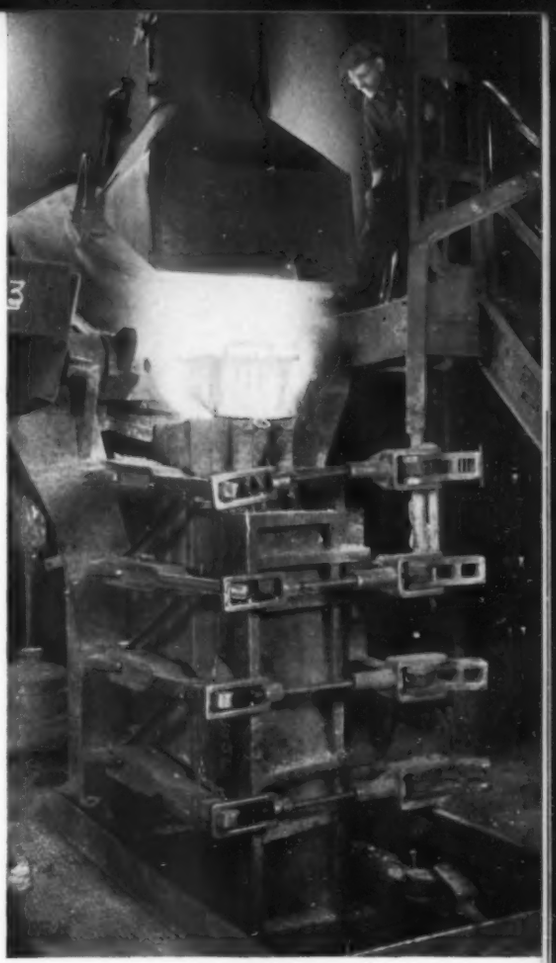
soda-fountain fixtures and fractional-horsepower electric motors.

Scovill products are today used in almost every industry. Alphabetically, they include air conditioning, automobiles, bicycles, clothing, dental supplies, elevators, furniture, gas appliances, hardware, instruments, jewelry, locomotives, novelty goods, oil burners, plumbing supplies, refrigerators, sporting goods, umbrellas, valves, washing machines and X-ray apparatus. For each of these random classifications, there are dozens more. Many of them are the result of expansion since the World War. Today, Scovill plants are bigger than ever before. And it is these facilities which, if needed, could once again produce vast quantities of munitions. Practically all of the company's equipment could be turned to this purpose.

The mill products division of the company would require little if any renovation in case munitions were to be manufactured in quantity. The casting shop has been re-equipped during the past ten years and instead of the oil-fired furnaces previously used there are 40 electric furnaces each of which handles 800 lb. of metal at a time. Melting and pouring temperatures are pyrometrically controlled within close limits. Two of the most recent advances in alloy casting are now in operation: Molten metal is poured from the furnaces into multiple molds, thereby forming four 200-lb. slabs simultaneously; consequently, each slab is formed at uniform temperature. The second innovation is the continuous casting of cylindrical billets from which required lengths for mill operations are cut.

The slabs of cast metal are trimmed in alligator shears and sent to the rolling mill where they are reduced 50 per cent in thickness. Following is an overhauling operation in which both sides of the slabs are scalped, removing scale and dirt. Further rolling reduces the slabs to required thicknesses for the various products manufactured. The casting shop and rolling mill have capacities 100 per cent in excess of the immediate needs of the remaining Scovill shops; consequently, they are already in a position to meet peak production demands should commercial activities cease in favor of munitions manufacture.

In the blanking department, shapes are stamped out of rolled sheet metal. Here are blanking presses, ranging from a large type for cutting heavy metal to a gang press with a speed of 200 strokes per minute; theses have outputs from a few thousand to hundreds of thousands of pieces per day. Drawing operations vary widely for the various products manufactured, and include every type from single drawing from blanks to multiple drawing directly from strips of sheet-metal. Drawn parts are sent during various stages of manufacture to an annealing shop containing electric,



Scovill's mill products division would require little if any renovation in case munitions were to be manufactured in quantity. Here is a heat from one of 40 electric furnaces being poured simultaneously into four molds, forming 200-lb. slabs of cartridge brass at uniform temperature

Slabs of cast cartridge brass for 75-mm. shell cases are shown being reduced 50 per cent in thickness immediately after molding. The casting shop and rolling mill, with capacities 100 per cent in excess of present needs, are today in a position to meet peak production demands should commercial activities cease in favor of munitions manufacture

A 200-ton press is used to cut circular blanks from which 75-mm. shell cases are drawn. The blanks are carried on an escalator to inspectors who examine them for surface defects.

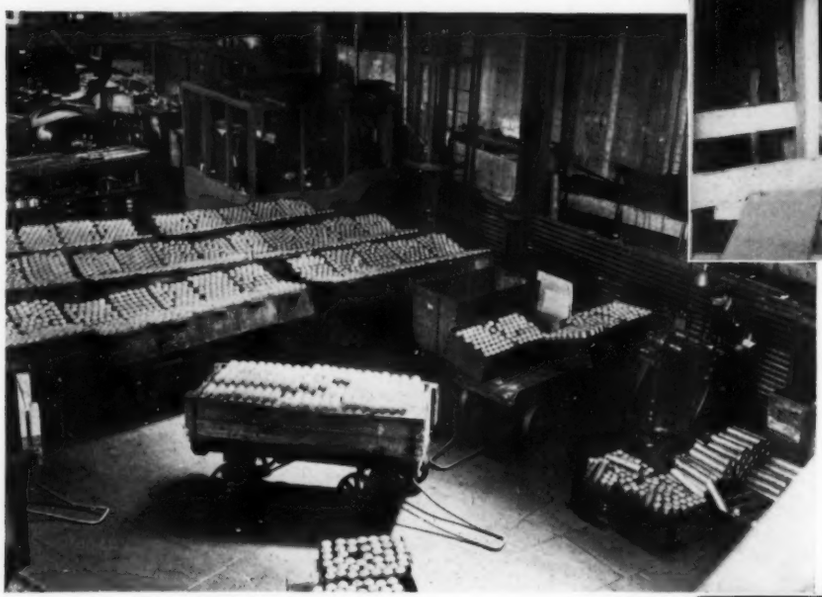
gas and oil furnaces. Automatic and semi-automatic threading, knurling, crimping, buffing and polishing machines are employed for finishing the many products.

In another department there are facilities for electroplating articles in chromium, nickel, brass, tin, zinc, cadmium, gold and silver. In still another there are automatic machines which lacquer up to 129,600 pieces per hour.

The Scovill Manufacturing Company has, at the present time, sufficient equipment tooled for the production of munitions to meet the peacetime allotments made by the war department. These war materials include 75-mm. cartridge cases, forged fuse bodies, primers and primer parts, center tubes for shell casings, percussion fuses, cups for 30, 45 and 50 caliber cartridge cases, parts for gas masks, disks from which all types of large shell cases are made, and metal gear for uniforms. All of these, with the exception of 75-mm. cases, are running in regular production with the many commercial items.

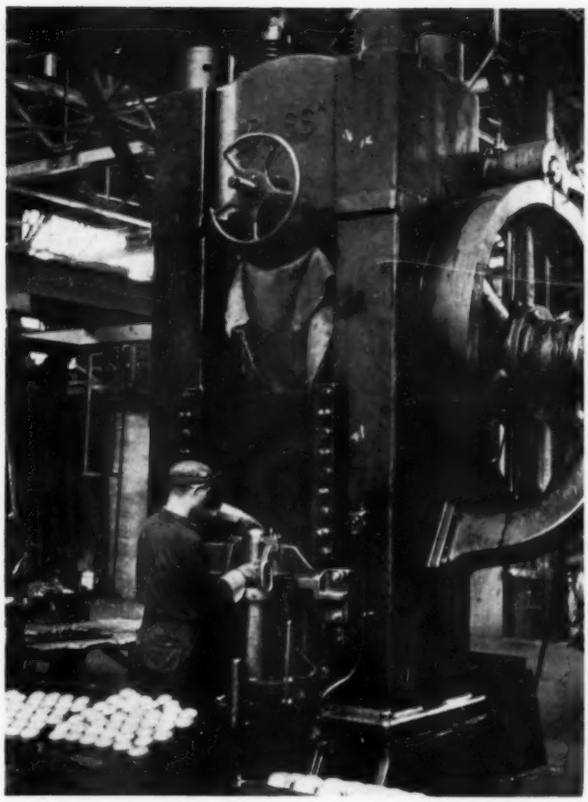
In making munitions, efficient production demands that certain equipment be set up in such a way that there be no back-tracking during the progressive stages of manufacture. This is not the case for commercial articles where for most efficient operation machinery is grouped according to types of operations rather than the type of product. However, with large orders for 75-mm. cartridge cases on hand, equipment for their manufacture is now being re-aligned. Some of it was used during the World

This operator is placing circular blanks in a 450-ton press which forms a cup with sides the same height as the diameter. Much of the metal remains in the base of the cup to form the head after the walls have been drawn to the required thickness and length



Following the last redrawing, each shell case has a heavy dome-shaped end, thin side walls, and a ragged open end. The cases are stacked in bins and sent to this trimming department where they are cut to uniform length

For trimming, the case is held in a revolving mandrel by a bell-mouthed tailstock brought against the dome-shaped end by a foot-actuated bell-crank. The ragged edge is removed by a cut-off tool moved by hand on a stationary cross-slide



Metal in the heavy dome end of the shell case is repositioned by a 1,000-ton press to form a flat head. The operator loads a case in a revolving holder, which indexes 180 deg., while the die at the back of the press forms the head in two blows

Flat turret lathes with collet chucks are used to finish machine shell cases. The head is faced and turned, and the primer hole is drilled, reamed and counterbored in successive operations, while a stationary tool at the back of the chuck edges the open end to accurate length

War period, but keeping up with modern manufacturing methods new facilities were installed recently, especially for annealing and machining the cases.

All of the cases are made from cartridge brass cast at the plant from Ajax 800-lb. electric furnaces. Four castings $1\frac{1}{4}$ in. thick are made simultaneously from each heat, and are immediately reduced 50 per cent in thickness by rolling. Dirt and scale is removed by a scalping or overhauling operation. Because of rigid specifications set up by the government, melting and casting temperatures are accurately controlled, chemical analyses of each heat are made, and thorough inspection is made at this and every other stage of manufacture.

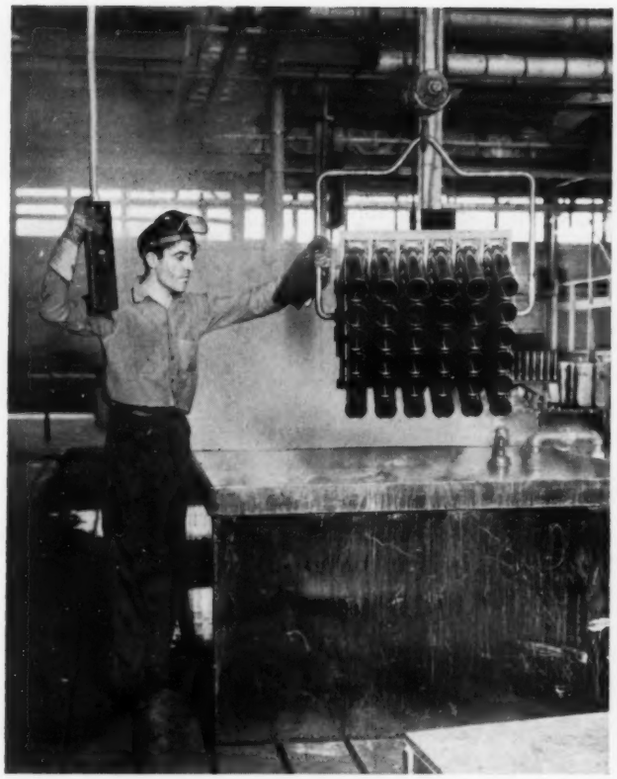
After overhauling, the slabs are rolled to the required thickness for cutting the blanks from which the cartridge cases are drawn. The thickness of the slabs is held to close tolerance to avoid forming non-uniform cups during the drawing operation. Every slab is gaged completely before blanking and rejected if not correct. Samples are taken from a number of slabs for each lot of cases and sent to the government for analysis.

The slabs are sent to the blanking department where a 200-ton Waterbury Farrel Foundry press is tooled to cut flat circular disks. Scrap material is removed by hand, while the disks fall from the die to an escalator running from beneath the machine. The escalator carries the blanks to a belt conveyor passing in front of inspectors who examine each piece for surface defects and burred edges. Any indication of a crack is probed and the blank is scrapped if any minute surface scratch is a potential defect. The blanks are stacked in small bins holding twenty-five pieces and are trucked to the drawing department. Should it be required to produce blanks in greater quantities than at present required, the blanking machine, and possibly others, would be transferred to a location adjacent to the first drawing press, thereby speeding production.

Drawing presses, trimming and heading machines and annealing equipment for 75-mm. cases are arranged for line production in one of the several rolling mills. This location was selected because of the weight of the various machines, because suitable crane, annealing and pickling equipment were already installed, and because of the proximity of this location to a building where facilities have been set up for finishing, inspecting and packing the cases.

In the drawing department the circular flat blanks are formed by a 450-ton Bliss press into a cup, the sides of which are approximately the same height as the diameter. The cups fall from the die through the base of the machine into a conveyor and are carried to an inspection bin. They are examined for uniformity of side-wall thickness and scratches; scratches at this stage would be dangerous inasmuch as they would be seared over in redrawing operations and possibly be hidden from view in the final product. A considerable portion of the metal remains in the base of the cup during this and subsequent drawing operations so that the head can be formed properly after the side walls have been drawn to the required thickness and length.

Following each of the drawing operations the pieces are annealed and pickled. They are placed in single rows in annealing pans and loaded on trucks which roll into muffle-type oil-fired furnace. Annealing temperatures



When the shell cases have been machined, the open ends are annealed in a molten salt bath for a limited distance only. The cases are placed in racks and moved from bath to bath by a remotely controlled monorail crane

The final operation on the shell case is that of tapering the open end so it will fit the breech of a gun. Afterwards the case is relief annealed to remove strains developed during tapering and to prevent season cracking

are accurately controlled to insure a definite size of grain growth, which is determined microscopically. After annealing, the pieces are stacked in large perforated steel buckets and moved by overhead cranes to sulfuric acid baths where all oxides are removed. Following a rinsing operation, the pieces are placed in small bins and moved to the next drawing press.

The cup goes through a series of redrawing operations in each of which the side-wall thickness is reduced materially with a consequent elongation of the shell. Bliss crank and rack-and-pinion presses from 60- to 250-ton capacities are used; final redrawing is done in a 60-ton press. After each redrawing, except the last one, the shell cases are annealed and pickled as described previously.

Following the last redrawing operation, the shell case has a heavy dome-shaped end, a thin side wall and a ragged edge at the open end. This edge must be removed by a trimming operation to bring all of the cases to uniform length for heading. In trimming, each case is placed individually on a motor-driven mandrel mounted on a lathe bed. The case is held on the mandrel by a bell-mouthed tailstock brought against the dome end by means of a foot-actuated bell-crank. A cut-off tool mounted perpendicular to the mandrel is moved by hand on a stationary cross-slide against the revolving case.

The trimmed cases are taken to a 1,000-ton Bliss toggle press where the metal in the heavy dome is repositioned to form the flat cartridge-case head. This is actually a cold-forging operation inasmuch as the cases are not annealed after the last redrawing of the side wall; this is necessary because definite specifications must be met regarding hardness of the finished cases around the primer hole and in the side wall adjacent to the head. The metal in the dome end is accurately proportioned so that during the heading operation it will flow evenly and re-arrange itself without fracturing. The heading press has a table which indexes 180 deg., thus enabling the operator to load one shell at the front of the machine while the dies are forming the head of case. Two blows are required to produce the finished shape because of the excessive movement of metal required.

The headed cases are boxed and trucked to the finishing shop, which was recently completed to enhance the manufacture of the 75-mm. shells. On arrival they are sent to a Bardons & Oliver flat turret lathe with a collet chuck. The head of the case is faced, the edge is machined, and the primer hole is drilled, reamed and counterbored in successive operations by the operator. A stationary tool at the back of the collet chuck edges the open end of the case to length, after which it is rolled and burred.

Adjacent to this machine is an inspector who gages each case for overall length, depth, head diameter, primer hole diameter, wall thickness and body diameter. The head is then stenciled in a hand-operated drop-hammer with the size of the case, factory name and the date.

The mouth of the case is annealed in a bath of molten salt for a limited distance only. This is done preparatory to tapering the end so that it will fit the breach of a gun. Afterwards they are relief annealed to remove strains developed in the tapering operations and to insure against season cracking.

The cartridge cases are finally cleaned, checked completely on all dimensions by both factory and government inspectors. A number of cases is subjected to ballistic tests before final acceptance and shipping of any given order.

GAGING BUSINESS

Volume of machine tool orders increases in some quarters although business varies greatly with individual companies. Foreign sales remain nearly constant.

Machine tool bookings in May were substantial, thanks partly to a rising volume of diversified domestic business. The disparity in sales and production between individual companies, however, is growing. Some builders are very busy, while others have little work on hand. The outlook is beclouded. Many prospective buyers are hesitant to make capital outlays for equipment until Government policies involving industry are more friendly. The indicated revision of taxes by Congress will be helpful in that respect. The machine tool people are less dependent than they were on foreign business which now accounts for about 40 per cent of the total compared with 52 per cent during 1938. A considerable volume of machinery orders is coming from aircraft and allied industries, as well as from direct Government sources.

NEW ENGLAND—Government orders are enabling metal-working plant to maintain operations at a good level. Most machine tool business is coming from aircraft companies, army arsenals and foreign sources. Some machinery companies have three-months' backlogs. Navy plans include $2,545,000 for dry dock modernization at the Boston yards, of which $600,000 will be spent for machine tools. Textile machinery sales are growing. Winchester has about completed placing tooling orders for production of 5,000 army rifles.

NEW YORK—Machinery sales were favorable in May. Airplane builders and companies producing aircraft parts are running on heavy schedules to keep abreast of government and foreign demands. French and British machinery buying missions are now in this country. Soviet purchases are expected to come to the front again soon. Machine tool orders at Philadelphia have emanated mostly from the government or from companies with government contracts.

PITTSBURGH—The steel rate has been accelerated by large bookings of flat-rolled products at lowered prices. As a result, mill operations will be higher in June than earlier anticipated. Machinery purchases in May declined from the April volume. Purchasing agents generally are retaining in their files quotations on recent inquiries, indicating that no action probably will be taken soon.

CLEVELAND—Some machine tool companies enjoyed better business in May than in April because of diversified domestic buying. Steel output has risen as mills started to roll initial automotive tonnage for '40 models.

DETROIT—Machinery purchase has been light, despite the nearness of the new model tooling period. A slight upward trend in sales of small tools and supplies is noted. Toledo metal-working plants are making few forward commitments for new equipment.

CINCINNATI—Several machine tool makers report May was better than April. They were encouraged by the rising percentage of domestic business. Others report decreased bookings and fewer inquiries. Much of the current orders are from aircraft companies, motor car makers and the government. Foreign business continues important.

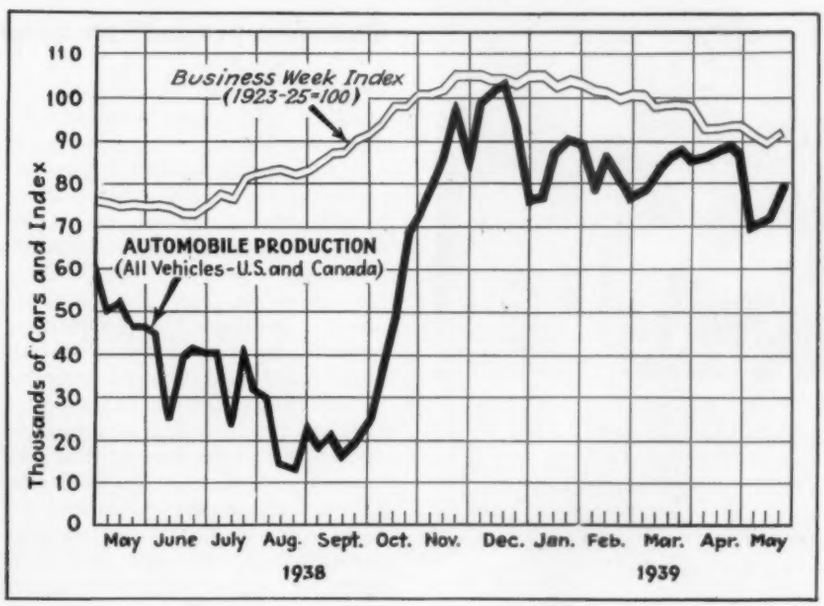
CHICAGO—Business opinion hinges on disappointment caused by failure to meet sales quotas set up in a burst of optimism last November and December. Many companies nevertheless, are doing better than in 1938. That is true, for example, of manufacturers of construction equipment. Farm implement and tractor makers are going along at a fairly good pace. Great Northern has ordered 14 switching Diesels, Burlington five and Pere Marquette one from Electro-Motive Corp. Inland Steel has started rebuilding plant 1 at Hammond, Ind. The steel rate is up a bit. Reports from machinery dealers are mixed, some having had less business in May than in April and others more.

ROCKFORD—A number of machine tool builders continue operations on multiple shifts. Incoming business has been of substantial volume the past month, with overseas buyers representing a smaller share than formerly.

ST. LOUIS—May sales of equipment were substantially the same as in April. Sentiment, however, is not good. Small manufacturers in Kansas City, such as Sterling and Turner Manufacturing, are going strong.

AUTOMOBILE PRODUCTION VS. GENERAL BUSINESS

With only a short run left on 1939 models, manufacturers have stepped up production to meet a considerably increased demand



In the "milling department," equipment such as milling machines, lathes, screw machines and shapers prepare tools and cutters for accommodation of the Carboloy insert prior to the brazing operation. Mercury-vapor lighting in this and other departments provides 50 foot-candles at the working plane

Pill presses in the air-conditioned powdered-metal room produce several hundred standardized tips or inserts per hour. This equipment is indicative of how economies can be brought about as standardization and simplification proceed with respect to shapes, sizes and grades

Carboloy Occupies

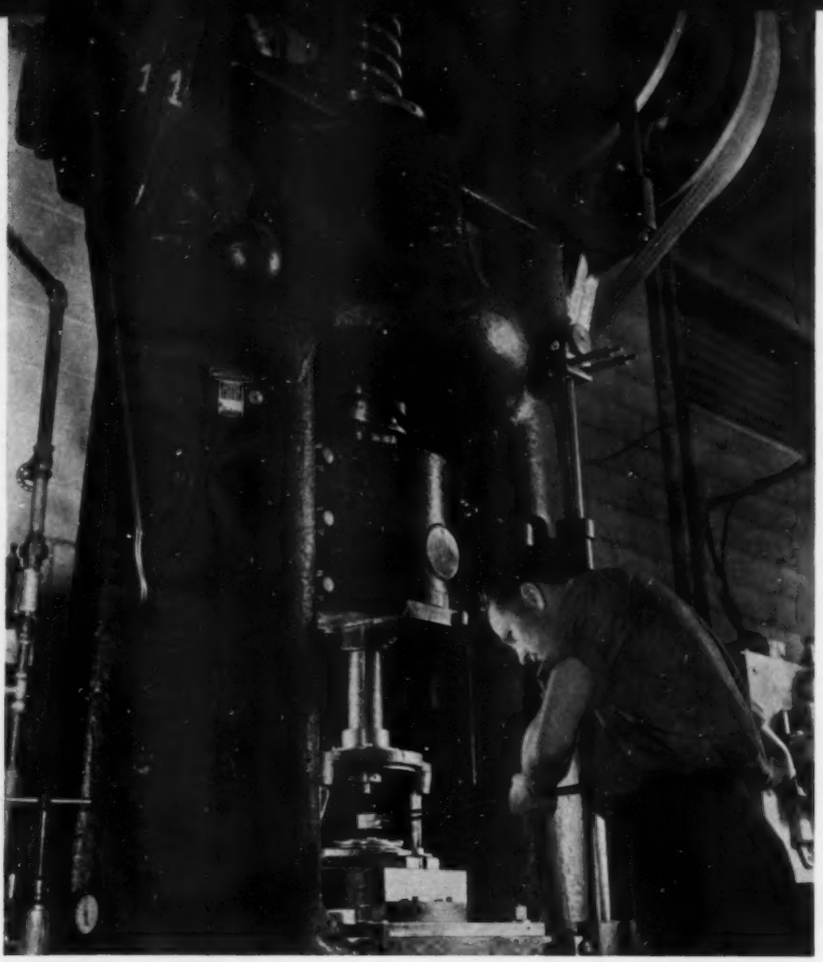
Quantity production of cemented carbides begins in a

DETROIT—Facilities formerly located at Cleveland, Stamford and downtown Detroit, for production of cemented-carbide tools, dies and wear-resistant parts, have been consolidated by Carboloy Co., Inc., in a new $750,000 plant on East 8 Mile Road. "This new plant," states W. G. Robbins, president, "provides the facilities for developing a progressively higher order of economy . . . and for more comprehensive use of cemented carbide throughout the industry."

Equipment installed and planned for the immediate future will be adequate for producing ten times the current consumption of cemented carbides in the United States. Every department has much space in reserve. Bays can be added to the factory building, and a 40-acre tract provides for what the future brings.

Carboloy's original facilities in Detroit alone were outgrown in three years' time. The other plants had the same trouble. The present undertaking is the result of a careful estimate of output requirements in the next few years. And coming at this time, it is of strategic value in the industrial preparedness program.

The factory building is a monitor-type, one-story, all-welded steel structure of 88,197 sq. ft. Complete facilities are installed to produce finished tools, dies and wear-resistant parts from the raw materials, that is, carbon, binders and tungsten, the latter being produced by an affiliated company. Production is controlled, and



Percussion presses hot-forge metal castings around drawing-die nibs so that support is provided on all surfaces except the hole; the operation is really a hubbing process, since the metal casing starts as a disk with no recess for the nib. Casings up to 9-in. diameter have been handled on the installed equipment

An intricate form on the shredder knife of a General Electric domestic garbage disposal unit is ground while the part is in the soft semi-sintered state, prior to final sintering

$750,000 Plant

plant with capacity of ten times present U. S. demand

research in product development is carried on, by a completely equipped laboratory located in the factory.

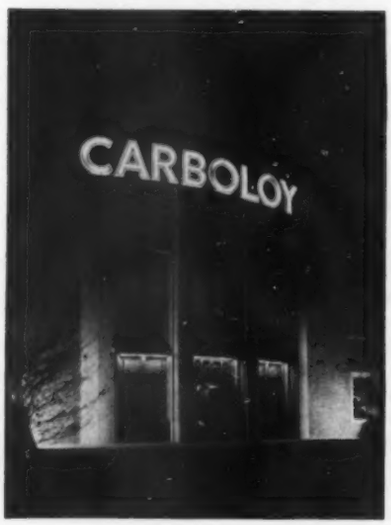
Several million grams of Carboloy can be produced monthly in the powdered-metal room, which is equipped with ball mills, crushers, sifting and mixing units. Part of this department is given over to storage facilities for 50,000,000 grams of raw and processed powders and to the pill presses and ingot presses.

The furnace room is equipped for reduction, carburizing, semi-sintering and brazing processes under close control and under quantity-output conditions. Furnaces in other departments are maintained for tool brazing and for heating drawing-die cases.

A wide variety of Carboloy blanks are shaped and sized in the forming department, which is equipped with many standard and special machine tools. Quantity production is enhanced by maintaining a large stock of semi-sintered ingots and cylindrical blanks in this department.

Shanks are recessed and special tool bodies are machined in the "milling" department, which is fitted out with standard and special high-production machine tools of various kinds for quantity and special orders.

After brazing inserts in place, tools are ground in another department fitted with batteries of surface, internal and cylindrical grinders, cut-off machines and diamond lapping machines. Dies are segregated in a special department.



NEWS OF THE INDUSTRY

METAL TRADES GROUP REVIEWS INDUSTRY, LABOR, GOVERNMENT

CHICAGO—Industry has its principles just as labor and government have theirs, and this being a democracy the right to fight for those principles is as much the province of industry as of any other faction. Thus ran the main theme of feeling and talk at the forty-first annual meeting of the National Metal Trades Association held here May 24–25.

N. W. Pickering, reelected president, reiterated the principles of the association which include retention of management control of industry and that no man needs to support a union to hold his job. Mr. Pickering cited the conservative swing to stiffer State legislation for labor as indicated by bills recently passed in Oregon and Wisconsin. He also pointed out the desire for change in the Wagner act and urged every industrialist to "tell his story" in Washington, as in the past. He reported that the association continues to improve its public relations program and is publishing a new manual on foremen training.

Heil Urges "Mixing in Politics"

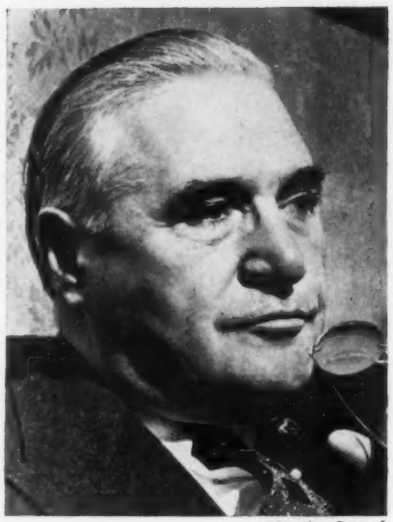
Governor Julius P. Heil in discussing men and management before 400 guests at the annual dinner pointed out that it is vital to know personally the men who work for you and asked that industry be "courageous" in fighting for what it knows to be right. He asked that industry mix in politics now so that the 1940 election might put sound management in charge of our government.

Progress in Job Evaluation Shown

From the practical viewpoint the report of the Committee on Job Evaluation and Merit Rating was the most important phase of the meeting. A. L. Kress of the association opened this session by summarizing the year's work and by saying that 100 plants had adopted the method since September, 1938. He introduced E. L. Berry, assistant general manager Link-Belt Co., Chicago, Howard Goodman, vice-president Goodman Mfg. Co., and John Brown of the Chain Belt Co., each of whom discussed the application of the association's method of job evaluation to his plant. They gave four outstanding advantages of the new method: (1) Definite coordination of the work done and the rate of pay without the bias of one supervising individual, (2) Ability to set rates of new work with accuracy, (3) The opportunity for advancement is thoroughly defined, (4) The foreman is better able to define work in the departments and to indicate why differentials are being paid. Limitations are that this is a new tool and like all tools must be studied for its best uses. Comparisons with wage rates in other plants must be made with care.

A primary difficulty in job evaluation is that of differentiating between the man and the job. The importance of the foreman in determining such factors was brought out in reports of the Committee on Merit Rating and Employee Analysis. W. W. Finlay, Wright Aeronautical Corp., explained a simple form which has been developed by the committee which is to be used by the foreman in rating the men in his department. A. S. Davis, Dexter Folder Co., explained the system of educating the foreman in using these rating charts and also gave details of methods used to classify the men rated. O. D. Reich, Dexter Folder vice-president, heads the committee which established the plan for placing the wage structure on a sound, scientific basis.

All officers of the association were reelected.



Milwaukee Journal

GOV. JULIUS P. HEIL

Naval Appropriations for 1940 Represent 24 Per Cent Increase Over Previous Sum

Replacement of Ships Involves Largest Single Item; Aircraft Expenditures Next

By BLAINE STUBBLEFIELD
McGraw-Hill Washington Bureau

WASHINGTON—Last major item of the Administration's gigantic defense program is the Navy appropriation for 1940, passed by House and Senate and going to conference as this is written. The bill carries $773,049,151 for all purposes, which is $149,522,957 more than the 1939 appropriation. Sixty per cent of the increase is for new construction.

Biggest item of interest is $270,000,000 for replacement of naval vessels, of which $15,795,288 is transferred to other Navy purposes. The balance of $254,204,712 will be used to carry on work on 121 vessels previously laid down under other appropriations, and to begin construction of the two 45,000-ton super-dreadnaughts authorized last year, two cruisers, eight destroyers, eight submarines, two seaplane tenders and one repair ship.

Total cost of these 23 vessels is estimated at $369,606,000, much of which will be appropriated after 1940. In addition, the Navy will continue or complete construction of four battleships, four aircraft carriers, one heavy cruiser, 11 light cruisers, eight destroyers, sixteen submarines and thirteen auxiliary vessels.

Plan for 500 New Planes

For naval aircraft Congress allows $88,298,000, including $5,000,000 of contractual authority. Of this amount, $51,898,000 will go for new airplanes; $1,500,000 for experimental work; and $500,000 for a rigid airship which has been dropped from the program probably for this year. It is estimated that 500 new airplanes can be procured with the appropriation, bringing the total to 2,132, which is 83 more than the old objective before last year's expansion act, but still 868 short of the 3,000 minimum set in that act.

The item for maintenance shows marked increase over last year's figure, which was $19,070,000. The Navy explains that in 1940 there will be an increase of 147 planes in operation.

About 638 new planes will be delivered during '39 and '40, of which 466 will be used during 1940. All are faster or heavier than older planes, and will require greater upkeep expense. During fiscal 1940, a total of 561 airplanes will require their first major overhaul, which will constitute 70 per cent of *total* major overhaul.

For repair to the fleet $37,746,429 will be needed. Twenty-eight old ships are scheduled to be commissioned in 1940, while 15 will be decommissioned. Thus there will be 13 additional ships in operation, bringing the total to 340. The above figure includes cost of target practice, supplies, and some other expenses.

Under the head of improvements, $4,000,000 is allocated to modernize the aircraft carriers *Lexington* and *Saratoga*. Total allocation for experimental purposes is $14,360,000, of which $5,305,000 is for type development of airplanes. For reserve materials $7,884,350 is required.

The Senate added two important items to the $53,000,000 public works bill: acquisition of the Hunters Point drydocks in San Francisco, and provision to construct a drydock at New York to handle the largest ships afloat. The bill at this writing has gone back to the House for consideration of these changes.

House Rules Committee has approved a bill from the Merchant Marine Committee authorizing the Coast Guard to build a base at Kodiak, construct three new cutters, and acquire 15 seaplanes at a cost of $14,223,000.

"CLEANING HOUSE" ADVOCATED AS STEEL PROBLEM SOLUTION

NEW YORK—The best contribution which the steel industry can make is to solve its own problems to the fullest extent possible under existing conditions, declared T. M. Girdler, president American Iron & Steel Institute, in an address at the annual meeting of that organization May 25.

Obviously referring to price demoralization within the industry, Mr. Girdler said that "when prices are lowered in the face of high costs without stimulating the general use of steel . . . the result is a step backward for a great industry and a blow to the national economy." He pointed out that war brings no prosperity to the steel industry, that government policies are leading the United States down the road to dictatorship, that sound national policy requires a labor law equitable to all classes and groups.

In making a plea for greater standardization in the steel industry, Benjamin F. Fairless, president United States Steel Corp., stated that multiplicity of composition, sizes and treatments adds to the cost of steel production. He suggested that the steel industry take stock of what it is producing and try to determine, with the aid of its customers, if unnecessary items are distracting attention.

The management of every steel company must realize the need for establishing sound "human relations," starting with labor relations, declared Arthur Roeder, chairman Colorado Fuel & Iron Co. James E. Lose, vice-president Carnegie-Illinois Steel Corp., advocated telling consumers the advantages of better size rollings, carrying on diligent research in new uses for steel, promoting frank discussion of the industry's problems with steel users, and pushing the work of standardizing carbon steels by grades.

After solution of a number of welding problems now being studied, the speed at which welding can be performed will be increased greatly, predicted Isaac Harter, vice-president Babcock & Wilcox Tube Co. He said that a marked reduction will be made in the volume of weld metal necessary to make a joint, with resultant minimizing of distortion. Steels will be specially created for strength and ready weldability .

Bradley Stoughton, dean of engineering, Lehigh University, read a paper on the training of a metallurgist. The steel industry of Great Britain was described by James Henderson, honorary treasurer Iron & Steel Institute, London.

Ernest T. Weir, chairman National Steel Corp., was elected president of the Institute to succeed Mr. Girdler. Mr. Fairless and Frank Purnell, president Youngstown Sheet & Tube Co., were elected vice-presidents. The Institute's medal was presented to John T. Whiting, president, Alan Wood Steel Co., Conshohocken, Pa.

British Press Combine

Shadow Plant Practice—*Modernization of British aircraft manufacturing facilities includes substitution of rolling for hand beating of sheet metal fairings. Above operations are being performed in the much-publicized Austin "shadow plant" at Longbridge, Birmingham*

HEAT-TREATING OF STEEL ALLOYS DISCUSSED AT A.S.M. MEETING

PHILADELPHIA, PA.—A one-day meeting of the Middle Atlantic chapters of the American Society for Metals included a technical session, a luncheon meeting, a plant visit, a trip to the moon and a dinner to complete a busy program. Cooperating were members of chapters representing York, Pa., New York, Penn State, Baltimore, New Jersey, Lehigh Valley and Philadelphia.

The morning session, held at the Manufacturers and Bankers Club was addressed by Dr. E. C. Bain, assistant to the vice-president, U. S. Steel Corporation, who spoke on functions of the several alloying elements in steel.

William F. James, president of the Philadelphia Chamber of Commerce, welcomed the guests at the luncheon meeting. Another speaker was George E. Whitwell, vice-president in charge of sales, the Philadelphia Electric Co., who pointed out the rapid growth in power load in the Philadelphia area because of increased manufacturing consumption. Visitors went by bus to the plant of the Alan-Wood Steel Co., at Conshohocken, Pa., where they inspected blast furnaces, coke ovens, open hearth furnaces and rolling mills.

WATCHING WASHINGTON

McGraw-Hill Washington Bureau

PAUL WOOTON, CHIEF

Opposition to spending huge sums for defense increases as additional data indicate need for more research instead of frantic production. Amendments to labor laws unlikely.

WASHINGTON—If the War Department helped the National Advisory Committee for Aeronautics to steal Lindbergh away from the Congressional committee circus, it repented somewhat last fortnight. Lindbergh called upon Congress to expand aeronautical research, as expected. But he also told the country it doesn't need to maintain a huge standing air fleet. If we just keep ahead in air speed and efficiency, that will be enough, said he. That is exactly the opinion of a strong minority on the Hill, which is making good use of the Colonel's report. Result is that the President's request for $250,000,000—the balance of the $300,000,000 for airplanes, Panama, and educational orders—is meeting some opposition. There has been no criticism, however, of the educational orders program as such. Meanwhile, both Civil Aeronautics Authority and Army Air Corps are pushing programs to train droves of airplane mechanics to meet wartime requirements. Army will put all its students in the service, but organized labor says that the civil training will glut the skilled-work market and later discourage good men from going into the trade.

Will Leave Labor Laws Alone

Doubt grows as to amendment of the Labor Relations Law and of the Wage-Hour Law. Pro-N.L.R.B. forces are stringing hearings along in hope the session will end and they won't have to expose the act to destructive bombardment on the floors. If they can't do that, they hope to dismiss the issue by accepting a few minor changes. On the Wage-Hour issue, five farm bureaus showed remarkable strength, forced House Labor Committee Chairman Mary Norton to withdraw her bill of amendments, one of which would have put under the law about 1,000,000 workers in the "first processing" of farm crops. Wage-Hour "pros" are scared stiff that opposition will bring amendments to the floors of Congress and reduce the Act to a "rubber gun."

"War-Laws" Prospects Fade

Neutrality legislation appears more unlikely as the President asks Congress to quit in June. The State Department is increasingly irked with exposure of all our family affairs in open hearings. Senator Borah's remark that there is no such thing as neutrality is growing on Capitol Hill. The proposal to conscript wealth along with manpower puts the swivel chair warriors on the spot; they believe that ready-made financing for a war would help to start one, but they can't think of convincing reasons why people with big money shouldn't pay accordingly.

More Millions for Planes

War Department has awarded $15,000,000 to Douglas Aircraft for an unstated number of all-metal monoplane attack bombers, minus engines, propellers, armament, radio, etc., which will be supplied by the Government to Douglas for installation. The latest features of this design are the result of observations of wars in China and Spain. Chief of the Air Corps says it is the best performer of its class in the world. The Department has also awarded to Seversky a number of YP-43 all-metal low-wing single-seat pursuit monoplanes, minus engines, meticulously streamlined for 350 m.p.h. and equipped with oxygen for altitude battle. Awards of about $500,000 each have gone to Glenn L. Martin and to Stearman Aircraft for production costs of their respective attack bombers, which are essentially the same as those entered in the Dayton competition.

OVERRULE ROOSEVELT?

In his address to the American Retail Federation President Roosevelt completely confirmed the prediction made in the May 17 issue of *American Machinist*. Not only that but he denounced the advocates of tax appeasement with the idea of aiding business as "gamblers" and "radicals."

Nevertheless Congress is inclined to gamble just as little. It does not propose to boost the straight corporation income tax to above 18 per cent. This is stiff but not in line with the frightening statements of certain Administration senators about 25 and even 30 per cent. Actually, removal of the "nuisance" corporation taxes will help those who are struggling, and not result in much loss of revenue.

Since May 17, also, Senator Pat Harrison, chairman of the Finance Committee, has taken the tax revision ball from the President, serving notice frankly at the White House of his intention to do so. Harrison told Chairman Doughton of the House Ways and Means Committee, which must originate any tax legislation, to pass "any bill you like" and send it over to the Senate. There the Roosevelt pet tax on undistributed earnings is apt to be eliminated. No one doubts the House will agree.

Patent Law Revision Certain

Look for a thorough job of patent law revision by Congress in 1940. Action will be held in abeyance this year, pending conclusions by T.N.E.C. American Engineering Council, in cooperation with the National Industrial Conference Board and National Association of Manufacturers, is making a 10-months' study of the patent system and expects to report next February. Observers predict that A.E.C. will be in general agreement with recommendations already made by Patent Commissioner Conway P. Coe last winter. Engineers and manufacturers do not intend to agitate in Washington but when revision starts they want to be there with sound arguments.

Who Knows the Answers?

Bigwigs from all bailiwicks appearing before the antimonopoly (T.N.E.C.) committee, are trying to answer two hard questions propounded by President Roosevelt to "Dear Joe" O'Mahoney, chairman. Is money idle in stagnant pools because (1) our economy is at the end of rapid expansion? or (2) because of lag, leak and friction in invetstment markets, diverting savings into nonproductive enterprise? There are many answers by brilliant men but they don't add up yet . . . Meanwhile Harry Hopkins wants $225,000 to hire "New Ability" for constructive work to be "welcomed by business."

Forts for the Atlantic

Military men expect that the War Department will soon ask heavy fortification in the newly created Puerto Rico department. This department ranks along with Hawaii, Philippines, Panama, and the corps areas of the United States. It's the "life-line" of this country through the Isthmus. The Navy is seeking shore property in Equador and Mexico for new bases to protect the Pacific side.

The smile of victory adorns the face of Charles F. Goedke, newly elected A.G.M.A. president. Right, U. Seth Eberhardt, new A.G.M.A. vice-president, discusses future plans with Frank B. Drake who crossed the continent to attend the meeting

R. M. Fellows and C. M. Peter take a look at the ocean and decide to stay out

Among the inveterate camera fans are Douglas T. Hamilton and A. A. Ross

GEAR MAKERS ELECT C. F. GOEDKE PRESIDENT

New Business Index is Announced at 23rd Annual Meeting Of American Gear Manufacturers Association

VIRGINIA BEACH, VA. — Gear manufacturers sought the sunny south for their three-day 23rd annual meeting. On May 15–17, at the Hotel Cavalier, Virginia Beach, they elected officers for the coming year, consumed their annual dinner, listened to a well-planned technical program, met in various committees and still had time for golf, swimming and the other sports that the resort afforded.

In opening the meeting, retiring president Howard Dingle, Cleveland Worm & Gear Co., announced the compilation of a new A.G.M.A. index which would be published in the business and daily press. He pointed out that since gear manufacturers supplied such a wide diversity of businesses, the index should be representative of general manufacturing conditions. Secretary-Manager J. C. McQuiston, explained how the index was computed and compared it with other available gages of business activity.

Among the association's guests, who spoke on technical subjects, were C. H. Bierbaum, Lumen Bearing Co.; J. R. Longstreet, The Warner & Swasey Co.; R. G. De La Mater, Parkersburg Rig and Reel Co., and G. L. Rothrock, Cadillac Division, General Motors Corporation. In speaking on materials for worm-gear drives, Mr. Bierbaum expressed a dislike for the practice of carburizing steel worms because of the effect on bronze worm wheels. He advocated nitrided Nitralloy or an oil-hardening S.A.E. steel.

Mr. Longstreet, in speaking about small lot gear production, pointed out that a permanent set-up of basic tools could be used in order to change from one job to another in a minimum of time. The application of gear reducers to oil-well pumping service was described by Mr. De La Mater. He discussed the various rigs used for this work, and by means of dynagraph cards, showed the unusual loads which this service entailed.

A study in compactness was offered by Mr. Rothrock who told of the development of a small automobile transmission. His description included manufacturing procedure as well as the steps in design.

Association members also made notable contributions to the program. T. R. Martins, Falk Corporation, who spoke on modern drafting room practice emphasized the necessity for cooperation between the engineering department and other departments in handling inquiries, analyzing orders, maintaining records, conducting research as well as taking care of its chief function in manufacturing design.

Safety was the subject presented by E. S. Sawtelle, Tool Steel Gear and Pinion Company. He told of several methods now being used to promote safety, among which was a method of rewarding workers in departments having perfect records.

Edward J. Wellauer, the Falk Corporation, spoke on considerations involved in gear metallurgy. He discussed modern gear materials and the properties that could, with proper treatment, be expected of them. Surface hardening of gear teeth was the

New A.G.M.A. Officers

President
Charles Goedke
Ganschow Gear Company

Vice-President
U. Seth Eberhardt
Newark Gear Cutting Machine Company

Treasurer
R. F. Marthens
Westinghouse Electric & Mfg. Company

Secretary
J. C. McQuiston

Executive Committee
R. C. Ball
Philadelphia Gear Works
Paul Christensen
Cincinnati Gear Company
F. B. Drake
Johnson Gear Company
* F. H. Fowler
Foote Bros. Gear & Machine Corporation
* J. H. Flagg
Watson Flagg Machine Co.
W. P. Schmitter
The Falk Corporation
° D. W. Diefendorf
Diefendorf Gear Company

* Committee Member Re-Elected
° New Member

subject of a paper by Dwight Van de Vate, Gleason Works. Materials and methods used in this process were described, and micro-photographs were shown to demonstrate the results obtained.

The importance of keeping correct cost records was stressed in a paper prepared by J. R. Fagan, Foote Bros. Gear & Machine Corporation, "Why the Chaotic Price Situation Within the Gear Industry?"

At the annual dinner two speakers presented the subject of industrial mobilization. Harry B. Jordan, Nansmond Ordnance Department, told particularly of the activities of the Industrial War College and its part in promoting national defense. Hartley W. Barclay, editor, *Mill & Factory*, discussed plans for meeting emergency demands by private industries.

WRIGHT, AIR CORPS DEVELOP 2,000-H.P. AIR-COOLED ENGINE

WASHINGTON—Equaling in power the giant 2,000-hp. Allison liquid-cooled aircraft engine, an 18-cylinder air-cooled radial engine has been developed by the Wright Aeronautical Corp. in conjunction with the Army Air Corps.

Known as the "Duplex Cyclone", the new engine is similar to the 1,500-hp. 14-cylinder double-row Cyclone from which it was developed. It consists essentially of two 9-cylinder radial engines mounted one behind the other on the same crankcase and driving a common crankshaft. The new engine is on display in the Army Air Corps exhibit at the New York World's Fair.

Presses Precision Parts—*Dies used by Westinghouse for molding porcelain parts achieve new accuracy in ceramics manufacture. Over 70 dimensions are rigidly held so that 30 metal parts will fit it exactly*

AUTOMOTIVE ENGINEERS PREDICT FUNCTIONAL DESIGN FOR FUTURE

NEW YORK—Automotive experts representing sixteen nations met May 22 at the Hotel Pennsylvania in New York City for the opening of the 1939 World Automotive Engineering Congress of the Society of Automotive Engineers.

Stressing the importance of "functional" rather than the "emotional" approach to automotive engineering problems, W. J. Davidson, Diesel Engine Div., General Motors Corp., and S.A.E. president, pointed out the innumerable possibilities regarding future automotive practice made possible by recent developments in new materials and methods of fabrication. Presided over by R. R. Teetor, the international opening session was devoted to further amplification of this theme, including an address by James D. Mooney, General Motors Corp., who discussed "Engineering, the Common Denominator of World Progress."

Following the opening May 22, the remainder of the week was devoted to many technical sessions involving more specialized interests. Included were four sessions on fuels and lubricants, three on passenger car engineering, three on transportation and maintenance, and two each on aircraft engines and diesel engines. Due attention was also paid to tractor, truck, bus and rail-car developments, with additional general sessions included in the program.

The following week the group entrained for Indianapolis, inspecting the famous International Speedway on Monday and attending the 500-mile International Automobile Sweepstakes the following day. The remainder of the week was spent in Detroit, where the engineers were shown through parts of the Ford, Chrysler and General Motors plants.

Plans call for the delegation to spend June 6-8 in San Francisco, where a number of additional technical sessions will be held. Emphasis will be placed mainly on aircraft and aircraft engine design and production, with further attention being paid to problems connected with fuels and lubrication.

U. S. Government Contracts Awarded to Metal-Working Firms

(Awarded from May 1–13 inclusive)

Contractor	Gov't Agency	Commodity	Amount
Lancaster Iron Works, Inc., Lancaster, Pa.	War, Engineer	Pipe	$69,840
Hayes Body Corp., Grand Rapids, Mich.	Navy	Shell blanks	16,775
Riverside Metal Co., Riverside, N. J.	Treasury	Bronze blanks for 1 cent pieces	38,750
Walter Kidde & Co., Bloomfield, N. J.	War, Air Corps	Fire extinguishers	42,639
Watson-Stillman Co., Roselle, N. J.	War, Ordnance	Hydraulic press	11,890
Cincinnati Milling Machine & Cincinnati Grinders, Inc., Cincinnati, Ohio	War, Ordnance	Milling machines	13,568
Lapointe Machine Tool Co., Hudson, Mass.	War, Ordnance	Broaching machine	11,474
Northwest Engineering Co., Green Bay, Wis.	Interior	Dragline excavator	23,839
Buffalo Pumps, Inc., Buffalo, N. Y.	Navy, S. & A.	Centrifugal pumps	21,850
Edward G. Budd Mfg. Co., Philadelphia, Pa.	Philadelphia Navy Yard	Sheaves	62,594
Cummins Engine Co., Columbus, Ind.	War, Engineer	Generating and distributing plant	57,234
Sperry Gyroscope Co., Brooklyn, N. Y.	War, Engineer	Anti-aircraft searchlights	30,419
General Electric Co., Schenectady, N. Y.	War, Engineer	Searchlight units	205,400
Aero Spark Plug Co., New York	Navy, S. & A.	Spark pugs	99,983
Grumman Aircraft Engineering Corp., Bethpage, N. Y.	Navy, S. & A.	Airplanes	1,562,838
United Aircraft Corp., Chance Vought Aircraft Div., East Hartford, Conn.	Navy, S. & A.	Airplanes	2,103,800
Wright Aeronautical Corp., Paterson N. J.	Navy, S. & A.	Engines	20,667
Leece-Neville Co., Cleveland, Ohio	War, Air Corps	Generator assemblies	34,440
Pump Engineering Service Corp., Cleveland, Ohio	War, Air Corps	Pump assemblies	69,093
Pittsburgh Screw & Bolt Corp., Pittsburgh, Pa.	War, Air Corps	Blade assemblies	51,300
United States Gauge Co., Sellersville, Pa.	War, Air Corps	Gage units	24,805
Bausch & Lomb Optical Co., Rochester, N.Y.	War, Engineer	Plotting instruments	39,802
David White Co., Milwaukee, Wis.	War, Engineer	Transits	20,920
Messinger Bearings, Inc., Philadelphia, Pa.	Navy, S. & A.	Steel rings	24,540
American Brass Co., Waterbury, Conn.	War, Ordnance	Brass cartridge disks	195,475
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn	Navy, S. & A.	Precision lathes	10,488
Gisholt Machine Co., Madison, Wis.	Navy, S. & A.	Balancing machines	17,560
Alliance Machine Co., Alliance, Ohio	Navy, S. & A.	Drop forge hammers	14,444
G. A. Gray Co., Cincinnati, Ohio	Navy, S. & A.	Planers	93,133
S. A. Woods Machine Co., Boston, Mass.	War, Ordnance	Shell machining	83,880
Jones & Lamson Machine Co., Springfield, Vt.	Navy, S. & A.	Turret lathes	15,957
Warner & Swasey Co., Cleveland, Ohio	Navy, S. & A.	Turret lathes	45,391
Foote Bros. Gear & Machine Corp., Chicago, Ill.	Interior	Gate hoists	41,577
C. H. Wheeler Mfg. Co., Philadelphia, Pa.	Navy, S. & A.	Deck winches	53,974
Ohio Brass Co., Barberton, Ohio	Interior	Switches	59,100
General Electric Co., Schenectady, N. Y.	T.V.A., W.P.A.	Circuit breakers, cable	69,583
Planetlite Co., Long Island City, N. Y.	W.P.A. Treas., Proc.	Lighting fixtures	20,993
The B. G. Corp., New York, N. Y.	Navy, S. & A.	Spark plugs	57,984
United Aircraft Corp., Pratt & Whitney Aircraft Div., East Hartford, Conn	Navy, S. & A.	Engines	570,694
United Aircraft Corp., Hamilton Standard Propellers Div., East Hartford, Conn.	Navy, S. & A.	Propeller assemblies	117,126
Steel Products Engineering Co., Springfield, Ohio	War, Air Corps	Bomb hoist assemblies	50,000
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.	Navy, S. & A.	Pressure gages	32,066

INSIDE DETROIT

By Rupert Le Grand
DETROIT EDITOR

Graham-Paige expects $3,000,000 aviation engine contract. Militant campaign started by U.A.W.-C.I.O. Auto sales sustained by late spring demand.

DETROIT—Military aviation and marine motors are soon to be produced by two local automobile plants. A prominent car maker has been developing an aviation engine, according to persistent rumors, and has been awarded a government contract. It is reported to have placed equipment orders in various machine tool centers on the basis of this contract. In addition, Graham-Paige is understood to be estimating on 150 engines for a foreign government.

Rumors that Cadillac is going into the aviation engine field have been denied by the management. From other sources it is learned that this plant will make the connecting rod, camshaft and crankshaft of the Allison engine built in Indianapolis by another General Motors division. The War department recently ordered 800 Allison engines for pursuit ships. Cadillac has the facilities for producing the above parts and has bought some additional equipment.

Millions Involved

Graham-Paige's project should be worth about $3,000,000, judging from the size of the contemplated order and the specifications of the engines. Considerable tooling-up will be involved, and no doubt this is figured into the initial contract. It is hoped later to get 500 more engines from the same buyer. And our own air services may become interested in an additional source of supply. The engine under consideration is to be built to the proved designs of an American citizen who was approached by foreign agents when it became apparent that that country's best water-cooled engine had reached the limit of its possibilities.

The first order of 150 engines would be broken down as follows: 50 twelve-cylinder 1,200-hp. aluminum-block motors for aircraft purposes; 50 twelve-cylinder 1,200-hp. iron-block engines for submarine chasers, and 50 sixteen-cylinder 900-hp. iron-block motors of a smaller bore for marine installation. The aluminum-block job is to have dry sleeves screwed into place under accurate temperature control. A contract is expected in a couple of weeks. Meanwhile, estimates are being obtained from various suppliers for important engine components. Graham-Paige will also buy considerable equipment for use in machining some of the parts.

C.I.O. Opens Fire

By "knocking off" the Briggs plants last week, the U.A.W.-C.I.O. served notice on the automobile industry that it is starting a campaign to force recognition of itself and its idea of a "union" shop. The twenty grievances over which the men struck were trivial in themselves and were used only as a pretext to force a bitter quarrel for a new contract. The management had asked the men to arbitrate the grievances, but this was refused. Other points of friction had developed between the management and the C.I.O. local in recent weeks, and the U.A.W. contract, once extended, had lapsed.

Workers Lose $1,000,000 a Day

Had the injunction suit between the U.A.W. factions been settled in favor of the C.I.O., a new contract might have been negotiated with considerably less trouble. But apparently the Thomas faction far outnumbers the Martin group among Briggs workers, and the former felt strong enough to force the issue now. Strike action was voted by the rank and file knowing full well that 15,000 Briggs workers, 50,000 Chrysler workers and several thousand parts-plants workers in the vicinity would be thrown out of employment if a Briggs stoppage exceeded a few shifts. A complete shutdown is calculated to cost the workers alone close to $1,000,000 per day.

Federal negotiator Dewey arrived promptly on the scene, presumably at the request of R. J. Thomas, president of the U.A.W.-C.I.O. His task will be made harder by the fact that negotiation of a contract will be tantamount to recognition of the C.I.O. faction as the sole bargaining agent, and that the union will no doubt increase its demands.

Strike Strategically Timed

Timing of the strike was nicely calculated to embarrass Briggs and Chrysler, while two or three weeks of good production were still required. If held up until June 15, the strike would have been more or less abortive, since all indications are that current model output will drop sharply by then and terminate by June 30. An agreement with the union in this case will probably have repercussions in further U.A.W.-C.I.O. demands for sole bargaining rights at Chrysler.

G. M. Situation Calm

General Motors is aloof, of course, from the Briggs controversy and has had remarkably little labor trouble over the past several months. Its "continuous" contract now appears to be a blessing in disguise. While it can be canceled upon 60 days' notice from either side, the supposition is that the C.I.O. forces will not move until next fall, if then. That faction must legally establish first of all that it is the union.

Martin's injunction suit has dragged along interminably, and seems to have backfired, judging by his counsel's lack of success in court arguments. Thomas declared that his group will carry on even if denied use of the U.A.W. name. From such turbulent actions as the Briggs strike, the Graham-Paige walkout and others where the pretexts are flimsy, it appears that automotive plants and parts makers will be kept stirred up by the U.A.W.-C.I.O. for some time.

Production Increases Slightly

Automobile sales showed spotty gains during the early part of May, causing some producers to up production, notably Chevrolet. Pontiac also increased schedules to 4,000 per week. Early weeks in the month accounted for around 75,000 units; during the middle of the month, increases brought the figure close to 85,000. But with the onset of the Briggs trouble, the weekly totals will be impaired during the final days of the month.

April production of passenger cars and trucks totaled 354,262 units for the United States and Canada. This was a drop of nine per cent from the March figure. May should par April.

New Equipment for Efficiency

Pontiac has taken a further step toward consolidating operations on station-type machines. It has purchased about $120,000 worth of equipment for the connecting rod line and about $40,000 for the main bearing cap. Five or six Greenlee automatics were bought to consolidate a number of operations on the connecting rod, using an indexing fixture, instead of a number of single-operation set-ups. Broaching machines also have multiple setups for finishing the side fit, the parting face, and the half round. Main bearing caps are being cast in a string and broached. The entire string is drilled, spot faced and sawed apart on a Natco. This method, reported first used by Packard, saves handling bearing caps individually in the foundry and in machine setups.

INDUSTRIAL CONFERENCE BOARD DISCUSSES RECOVERY PROBLEMS

NEW YORK—Problems of reconstruction were discussed by a group of notable speakers at the twenty-third annual meeting of the National Industrial Conference Board here on May 24. Senator Joseph C. O'Mahoney made a plea for freedom of commerce and industry from arbitrary restraints, for wise governmental tax policies to encourage business, for building up small business, and for greater participation of labor in the production of industry.

"Corporations will not undertake programs of reequipment or expansion, nor will they launch new products in an anti-business atmosphere or in the face of tax policies inimical to profits," declared Robert M. Hanes, vice-president American Bankers' Association. C. W. Kellogg, president Edison Electric Institute, said that the complexities of modern business have made a great increase of government regulation inevitable, that industry should recognize this fact, and that business leaders should work with government to guide this regulation into sane and useful channels for the public good.

Equality of treatment of various forms of transportation would encourage railroads to make more investments in better plant equipment, commented J. J. Pelley, president Association of American Railroads. It is far better, asserted Matthew Woll, vice-president American Federation of Labor, that capital investments be encouraged to bring about reemployment than that attention should be centered on providing relief and in finding new excessive and burdensome forms of taxation. Said Dr. Virgil Jordan, president the Conference Board, "If the American people are to succeed in reconstructing the kind of American life they want, they must recapture from political exploitation a vast province of social activity and resources and be prepared to resume and assume responsibilities for its administration."

A.S.M.E. FORMS SUBCOMMITTEE TO CHECK THREAD STANDARDS

NEW YORK—A special sub-committee of the American Society of Mechanical Engineers has been appointed to supervise a series of tests on screw threads, it has been revealed by Earle Buckingham, secretary of the Committee on the Standardization and Unification of Screw Threads. To be made in order to obtain test data on the influence of errors, elasticity, and plasticity on the strength of screw threads, these tests have been necessitated by difficulties encountered in meeting the present screw thread standards in manufacture, and by numerous types of failure encountered in service.

The committee plans to conduct these tests at the Massachusetts Institute of Technology, and subsequently to propose revisions in the present American Standards for Screw Threads, B1.1-1935, "so that this standard may represent more exactly the properties of a threaded product which will give the required service." At a meeting of this committee held recently under the chairmanship of Ralph E. Flanders, discussion centered on several disadvantages of the present type thread.

Centrifugally Cast Gears—*With these eighteen rotating dies mounted on a revolving turntable, Ford centrifugally casts blanks for differential and transmission gears. Dies spin at 190-400 r.p.m., depending on gear size. Turntable takes about four minutes for a complete revolution*

CENTRIFUGAL CASTING OF GEARS PUT INTO PRODUCTION BY FORD

DETROIT—Ford is now casting gear blanks in centrifugal dies on a production basis. All Ford truck ring gear blanks are being made by the centrifugal method, according to R. H. McCarroll, Ford metallurgist. The process will be extended to full manufacture of the car ring gear and transmission cluster gear as rapidly as necessary equipment is installed.

Greater strength, lighter weight and faster production are the principal advantages of gears made by the new method. By the use of sand cores in the die, undercuts can be made which would be impossible in a conventional forging, saving weight and metal. The metal is equally strong in all directions, indicated by absence of all flow lines in the castings.

Process Fundamentally Simple

The centrifugal method is simple. Eighteen dies, made of a special low carbon steel, are mounted on a turntable designed and built by Ford engineers. Each turntable begins to spin as it approaches the pouring ladle, continues to whirl for the two minutes required for the metal to solidify, and then stops turning in time for the operator to remove the hot blank and prepare the die for the next casting.

Centrifugal force is used to lock the dies in position. This is done by "dogs" pivoted in the middle. There is a weight on one end, a hook on the other. When the die spins, the weight flies out and drives the hook onto a ledge on the top half of the die, securely locking it into place. When the die ceases to spin, the weight falls, automatically releasing the die for removal of the gear blank.

Only Three Men Required

One man loads the cores into the dies and sets in position the top half of the die, another pours the molten steel, and a third removes the die top and gear blank. A complete revolution of the turntable takes about four minutes. Dies for the truck ring gear are spun at 190 r.p.m. For the smaller car ring gear blank, the speed is 325 r.p.m., for the transmission cluster gear 400 r.p.m.

Centrifugally cast gears were subjected to searching laboratory tests and to hundreds of thousands of miles of service before being accepted for production.

PERSONALS

WALTER GEIST

W. R. G. BAKER

WALTER K. BAILEY

WALTER GEIST has been appointed vice-president, Allis-Chalmers Mfg. Co., Milwaukee, Wis. Mr. Geist first entered the employ of Allis-Chalmers in 1909 as an errand boy in the saw mill engineering department. Later, in the flour mill department, he became interested in matters pertaining to design, with particular reference to power transmission. As a result of this, he worked on the idea of the multiple V-belt drive principle of power transmission, which resulted in the development of the Texrope drive. In 1928 Mr. Geist was made assistant manager of the milling department, and three years later was appointed general representative, supervising the personnel of the company's district offices.

H. Y. BASSETT, formerly with the Surface Combustion Corp., has joined the staff of the Wolverine Tube Co., Detroit, Mich., as research engineer.

H. D. BOWIE, formerly with the Cadillac Motor Car Co., Detroit, Mich,. has been named superintendent of the Blanchard Machine Co., Cambridge, Mass.

IVAN H. ENGSTROM, formerly factory superintendent Dictograph Products Co., has been appointed assistant plant superintendent of the Gray Telephone Co., Hartford, Conn.

JOHN E. HALBING has been appointed assistant general manager of the Painted Post, N. Y., plant of the Ingersoll-Rand Co. For the past several years he has been works manager of the company's Trafford Park plant in Manchester, England.

GORDAN F. HESS, former assistant sales manager of the alloy steel division, Republic Steel Corp., Massillon, Ohio, has been appointed Houston district sales manager.

C. H. KUTHE has been appointed technical advisor to the Michigan Div., Revere Copper & Brass, Inc., New York, N. Y.

RUDOLPH S. RAUCH has been elected vice-president of the North Bros. Mfg. Co., Philadelphia, Pa., manufacturer of "Yankee" hand tools.

E. EARL REUWER has been elected secretary and treasurer of the American Bosch Corp., Springfield, Mass., to succeed E. J. WAGENER, resigned.

J. P. ROGERS, former vice-president Crosley Corp., has been elected vice-president and treasurer, Farnsworth Television & Radio Corp.

W. R. G. BAKER, chairman of the radio management committee, General Electric Co., Schenectady, N. Y., has been appointed manager of a new department of the company which will consolidate for the first time all radio, television and related activities. The new department has been established at the Bridgeport, Conn. plant of the company.

ROBERT A. NEAL, former assistant vice-president, has been appointed manager of the switchgear division of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Mr. Neal has been associated with Westinghouse since 1910, when he was graduated as an electrical engineer from the University of New Hampshire. He was assigned to the switchboard sales group the following year and within four years had been named assistant manager of the group. Five years later he became manager of the entire switch department, and was again promoted in 1926 to sales manager for all switchgear apparatus. Mr. Neal held this position until 1931, when he became manager of the central station sales department, later to be appointed assistant to the vice-president.

WILLARD H. COBB, for the past several years general factory manager, mechanical goods plants, United States Rubber Co., has been appointed general manager of the mechanical goods and general products divisions.

R. W. EICHENBERGER, vice-president, Robins Conveying Belt Co. and former manager of its Chicago office, has been transferred to the company's home office in New York, N. Y.

J. W. SAVAGE, formerly with the appliance and merchandising department, General Electric Co., Bridgeport, Conn., has been named assistant to C. E. WILSON, executive vice-president, with headquarters in New York, N. Y.

WALTER K. BAILEY, assistant sales manager Warner & Swasey Co., Cleveland, Ohio, has been made sales manager. He succeeds CLIFFORD S. STILWELL, recently elected executive vice-president. Mr. Bailey entered Warner & Swasey as a special apprentice immediately following his graduation from Oberlin College in 1919. The following year he left the company to go into the retail store field, and a year later returned to Oberlin College as instructor of physical education. He rejoined Warner & Swasey in 1922 as a salesman in the Chicago territory. Two years later he was made sales manager of the Cleveland district, and in 1936 became service manager, spending most of his time in developing a new line of standard tools for the company. He became assistant sales manager in 1938.

P. Y. DANLEY, Westinghouse Electric & Mfg. Co., Springfield, Mass., has been elected president of the Air Conditioning Manufacturers' Association. Other officers elected include S. E. LAUER, York Ice Machinery Corp., York, Pa., vice-president; P. A. MCKITTRICK, Parks-Cramer Co., Fitchburg, Mass., treasurer; and W. B. HENDERSON, Washington, D. C., executive vice-president.

HENRY S. WASHBURN, president and treasurer Plainville Casting Co., Plainville, Conn., has been elected president of the American Foundrymen's Association. LESTER N. SHANNON, vice-president Stockham Pipe Fittings Co., Birmingham, Ala., has been named vice-president.

Directors elected include: MARSHALL POST, vice-president Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.; FRED J. WALLS, Detroit manager International Nickel Co., New York, N. Y.; WILLIAM B. COLEMAN, president W. B. Coleman & Co., Philadelphia, Pa., and OTTO A. PFAFF, vice-president and general manager American Foundry Equipment Co., Mishawaka, Ind.

BUSINESS ITEMS

Ajax Flexible Coupling Co., Westfield, N. Y., has appointed the Chicago Pulley & Shafting Co., Chicago, Ill., as distributor.

Alemite Die Casting Co., Woodstock, Ill., a subsidiary of Electric Auto-Lite Co., is building a plant addition containing 90,000 sq.ft. of manufacturing space.

Allis-Chalmers Mfg. Co., Milwaukee, Wis., has received a contract for a 50,000-kw. turbine from the **Commonwealth Edison Co.,** Chicago, Ill., which has placed orders for new equipment amounting to over $2,500,000 as part of an extensive expansion program. Sharing in the award were the General Electric Co., Schenectady, N. Y., and the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., which are furnishing transformers, switching apparatus and other equipment.

American Engineering Works, Philadelphia, Pa., has acquired the Diamond Machine Co., Providence, R. I.

American Flexible Coupling Co., Erie, Pa., has appointed A. H. BURNAP, Syracuse, N. Y., as its central New York State representative. ERIC N. GILLING, Pittsburgh, Pa., has been appointed West Virginia and western Pennsylvania representative.

Chance - Vought - Sikorsky Div., United Aircraft Corp., Stratford, Conn., is constructing plant addition costing $350,000 to provide added manufacturing facilities. The company recently received a $2,000,000 contract to supply the U. S. Navy with airplanes.

Chicago Metallic Mfg. Co., Chicago, Ill., is constructing an addition to its plant at a cost of approximately $25,000.

R. W. Cramer Co., New York, N. Y., manufacturer of electrical timing devices, has moved to Centerbrook, Conn.

Delta Mfg. Co., maker of metal-working and wood-working machinery, Milwaukee, Wis., has been sold to the Timken Detroit Axle Co. An exchange of stock, said to involve about $1,000,000, effected the sale. Delta employs about 200 at the present time.

Ducommun Metals Co., Los Angeles, Calif., is planning to erect a steel storage building at a cost of $300,000.

Hobart Mfg. Co., Troy, Ohio, is planning to build a three-story plant addition and a new brass foundry. Contracts for the construction have been awarded to the Austin Co., Cleveland, Ohio.

Keystone Steel & Wire Co., Peoria, Ill., has acquired the National Lock Co., Rockford, Ill.

Lobdell Car Wheel Co., Wilmington, Del., has purchased the Nazel Engineering & Machine Works, Philadelphia, Pa., which will henceforth be operated as the company's Nazel Hammer & Dill Slotter Div., under the direction of HOWARD W. WIMER, for 35 years associated with the Nazel organization.

OBITUARIES

JONATHAN E. BROWNING, inventor of the Browning rifle, died May 16 in a New Haven, Conn., hospital following an operation for appendicitis. He was 80 years of age. Mr. Browning achieved international recognition with the invention of a machine gun which played a prominent part in the World War. Since the death of his brother John in 1926, he was occupied in perfecting patents left him, and more recently had been associated with the Winchester Repeating Arms Co. in connection with a new gun model of his own design.

R. N. BUNN, 83, for 30 years secretary of the Benjamin H. Bunn Co., Chicago, Ill., tying machine manufacturer, died May 14.

CHARLES F. DE GANAHL, 69, maker of the first all-welded steel barges in this country and prominent in the formation of Fleetwings, Inc., Bristol, Pa., manufacturer of stainless steel airplanes, died May 13 in New York City.

BENJAMIN G. FOLLANSBEE, 87, co-founder Follansbee Bros. Steel Co., Follansbee, W. Va., died May 10 in Pittsburgh, Pa.

JOHN C. GORTON, mechanical engineer associated with Union Twist Drill Co., Athol, Mass., died May 11 at his home in that city. He was 73 years of age.

CASS A. LAMB, general manager Great Lakes Forge Co., died May 14 at his home in Kalamazoo, Mich. He was 54 years old.

GEORGE CARTER MILLER, 64, president Dodge Mfg. Corp., Mishawaka, Ind., manufacturer of power transmission equipment, died May 10 of heart trouble. Mr. Miller became president of Dodge Manufacturing in 1923. He had been superintendent of Charles Williams Stores; general manager Montgomery, Ward & Co.; general manager Beaver Products Co.; president Tillotson Mfg. Corp.; and vice-president George W. Goethals Co.

GRANT MONK, 48, Gary rail mill superintendent Carnegie-Illinois Steel Corp., died May 10 of a heart attack.

WILLIAM G. PURDY, 62, founder, president and general manager Tiffin Art Metal Co.; Tiffin, Ohio, died May 10 following a brief illness.

W. C. STEVENS, since 1930 secretary and vice-president in charge of engineering Cutler-Hammer, Inc., Milwaukee, Wis., died May 15 at the age of 55. A member of the firm since his graduation from Cornell in 1906, he became sales manager in 1917 and director of development in 1924. He was also a director of Globe Union, Inc.

CHARLES H. STRAWBRIDGE, president Goodman Mfg. Co., Chicago, Ill., and in 1937 president of the National Metal Trades Association, died May 15 of a heart attack at his home in Chicago. He was 66 years of age.

GEORGE A. YANOCHOWSKI, 51, for nine years president Kellogg Switchboard & Supply Co., Chicago, Ill., died May 14.

MEETINGS

AMERICAN ELECTRO-PLATERS' SOCIETY. International convention, Asbury Park, N. J., June 19-22. W. J. R. KENNEDY, executive secretary, 90 Maynard St., Springfield, Mass.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Combined Summer and Pacific Coast convention, San Francisco, Calif., June 26–30. H. H. HENLINE, secretary, 33 W. 39th St., New York, N. Y.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Semi-annual meeting, San Francisco, Calif., July 10–14.

AMERICAN SOCIETY FOR TESTING MATERIALS. Annual meeting and exhibit of apparatus and instruments, Chalfonte-Haddon Hall, Atlantic City, N. J., June 26-30. R. E. HESS, assistant secretary, 260 S. Broad St., Philadelphia, Pa.

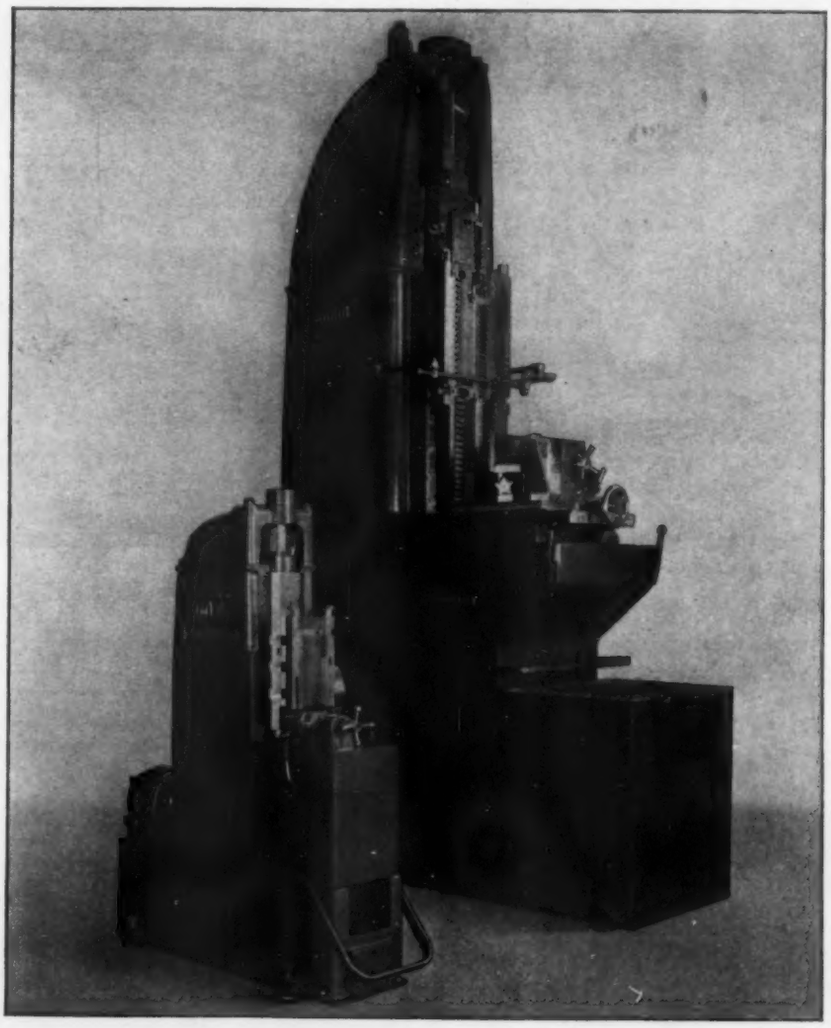
ASSOCIATED MACHINE TOOL DEALERS OF AMERICA. Spring convention, Van Curler Hotel, Schenectady, N. Y., June 5 and 6. THOMAS A. FERNLEY, JR., executive secretary, 505 Arch St., Philadelphia, Pa.

SHOP EQUIPMENT NEWS

Vertical "Hydro-Broach" Machines Have Fixed or Receding Tables

The line of single-ram vertical "Hydro-Broach" machines announced by Cincinnati Milling Machine & Cincinnati Grinders, Inc., Cincinnati, Ohio, are built in twelve standard sizes, from the No. 1-18, with an 18-in. ram stroke and 2,000 lb. normal broaching force to the No. 15-60 with a 60-in. ram stroke and 30,000 lb. broaching force. These machines are available either with fixed or receding tables. The standard fixed table machines are built for single cycle operation and the ram stops at the end of each stroke. Completed work is removed at the end of the cutting stroke and new work is placed in the fixture while the ram is stopped at the end of its return stroke.

Either full automatic or single-cycle operation may be arranged with the receding table type machine. Work is loaded, in the full automatic cycle, as the ram returns to the starting position following the completion of the cutting stroke. The table advances to the broaching position, the ram makes a cutting stroke, the table recedes, and the cycle repeats itself. For a single cycle operation of the receding table type machine, the ram is stopped at the top of the return stroke and the operator unloads and loads the work.



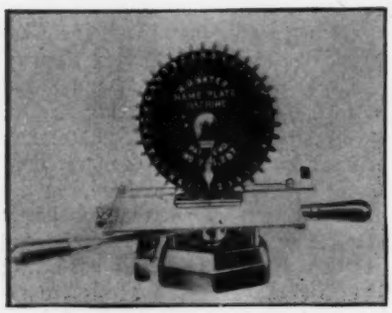
Both types of machines, regardless of the operating cycle, may be stopped instantly by shifting the hand levers at each side of the operating station, or by stepping on the foot treadle. Instant reversal by means of the dual hand levers also is provided. In the single cycle machines the two levers require simultaneous use of the operator's hands, preventing starting the machine until the hands are removed from the cutting area. A latch device returns the table to broaching position within 0.0003 in. on both full automatic and single cycle operation of the receding table type machine.

A speed control valve for the ram can be built into the broaches at the factory. Standard ram speeds start at 41 ft. per min. forward, and 81 ft. per min. return on all broaches with 2,000 lb. force and decrease to 26 ft. per min. forward and 51 ft. per min. return on broaches having 30,000 lb. force.

Coil Stock Cradle Is Driven Hydraulically

Supporting rolls of this single-disk coil stock cradle announced by the Cleveland Punch & Shear Works Co., 3900 St. Clair Ave., Cleveland, Ohio, are rubber covered to prevent marring or scratching the surface of the material. They are so arranged that as the coil decreases in size, the rollers continue to bear on the outside of the coil. This cradle will handle a 3½-ton coil measuring 52 in. outside diameter and 20 in. wide as a maximum. The cradle is power driven by a variable speed hydraulic unit located in the base. It can be connected with the starting and stopping mech-

anism on the feed table so that both will operate simultaneously. Shown in an inclined position, this cradle also can be furnished in an upright position.

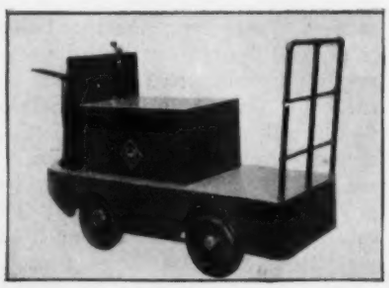


Improved Stamper Marks Nameplates

An improved nameplate stamping machine that will mark plates measuring up to 8 x 5 in. is offered by H. O. Bates, 251–257 N. Broad St., Elizabeth, N. J. This machine has a $\frac{3}{8}$ in. vertical adjustment for different thicknesses of plate, and has a throat depth of 3 in. Length of automatic advance is $4\frac{1}{2}$ in. It is furnished with dies assembled of any one size from $\frac{1}{16}$ to $\frac{9}{16}$ in. Extra wheels with dies assembled are interchangeable.

Type IE Truck-Tractor Has Welded Frame

Frame of the Type IE truck-tractor announced by The Elwell-Parker Electric Co., 4205 St. Clair Ave., Cleveland, Ohio, is made up of heavy section formed plates welded into a one-piece construction, including control dash and pedal guard. This truck has a rated capacity of 3,000 lb., and has four speeds forward and four reverse. Having a wheel base of 37 in. and an over-all length of 84 in., this truck is claimed to be fast, easy to manipulate and compact. Platform is fitted with a detachable end gate which may be adjusted so as to carry additional load. Provision also is made for pulling trailers.



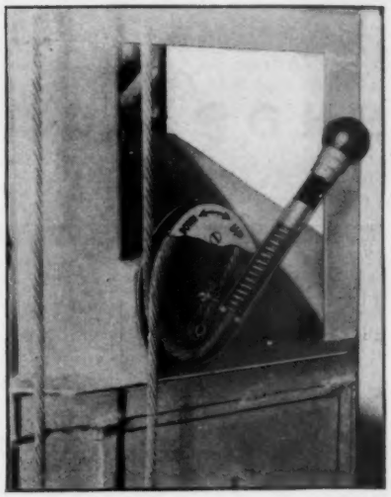
"Junior" Presses Have ½ ton Capacity

"Junior" hydraulic broaching and assembly presses, offered complete with motor, hydraulic power unit and controls by Colonial Broach Co., Detroit, Mich., measure only 31 in. in over-all height, and have a capacity rating of $\frac{1}{2}$ ton. Stroke is adjustable up to

10 in. These presses are designed so that they may be mounted on standard benches, having a base area of 12 x 22 in. Vertical mounting of the 1-hp. motor within the machine permits locating the press in a limited space. Platen measures 8 x 12 in. and there is a 5-in. clearance between the ram and machine frame.

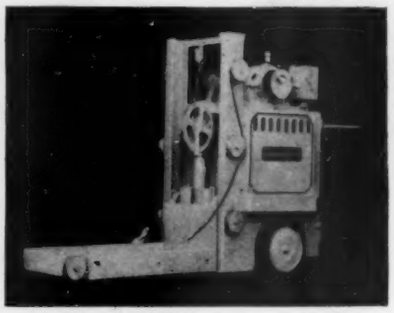
Stacker Control Is Self-Adjusting

The Lewis-Shepard Sales Corp., 245 Walnut St., Watertown, Mass., has announced the development of an improved operating control which is being applied to all power-operated stackers. This control is contained in a dust-proof housing and is mounted on both sides of the stacker, so as to allow the operator to control the machine from either side. Little effort is required to operate the control, as there are no links or intermediate gears. The control is self-adjusting, as the cable automatically is extended and taken up by a long spring within the controller handle.



Winch is Mounted on Model A-1006 Truck

Loading and unloading of dies is facilitated by the double-drum electric motor driven winch assembly mounted over the battery compartment of the Model A-1006 electric industrial truck offered by the Mercury Mfg. Co., 4118 S. Halsted St., Chicago, Ill. This vehicle has a



platform, measuring 24 x 48 in., which elevates from a lowered height of 9 in. to a maximum height of 52 in. The truck has an over-all height of 66 in. Removal of load from the platform of the truck is effected readily by reversing the direction of the pull of the cables around the platform sheaves.

Sensitive Control Provides Rapid Cycles

Hannifin Mfg. Co., 621–631 S. Kolmar Ave., Chicago, Ill., has developed a senstive pressure control for use

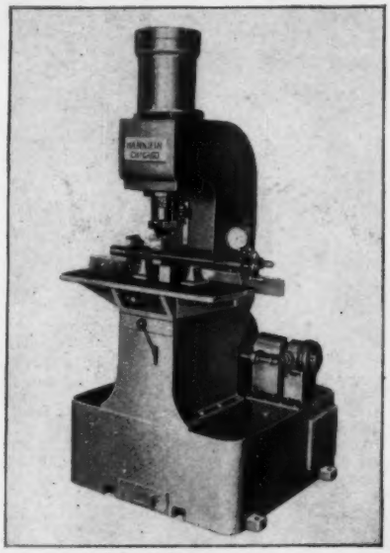
Since 1898 — more than 41 years of doing one thing well—concentrating on the building of milling machines exclusively has won for the Kearney & Trecker Corp. world-wide recognition for the most advanced milling machine design and construction.

KEARNEY & TRECKER CORPORATION
MILWAUKEE, WISCONSIN

MORE THAN 41 years OF DOING ONE THING WELL

K&T

Milwaukee **MILLING MACHINES**

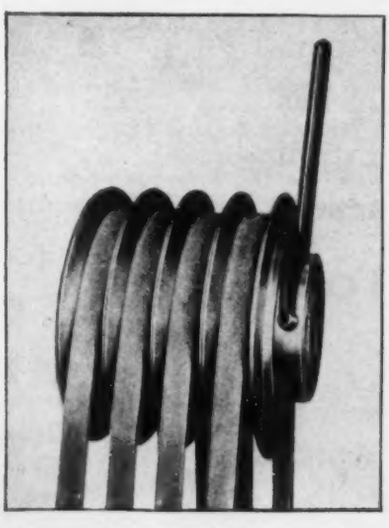


on Hannifin hydraulic presses for straightening, forcing, assembly and similar operations. The press shown is a 20-ton high-speed straightening press equipped with both hand and foot lever control.

Operation of the improved pressure control permits a rapid operating cycle, with finger-tip or light foot control of the ram movement on the advance stroke, and of ram pressure during the working stroke. Ram movement, both up and down, and pressure control is accomplished by means of a single lever or foot pedal.

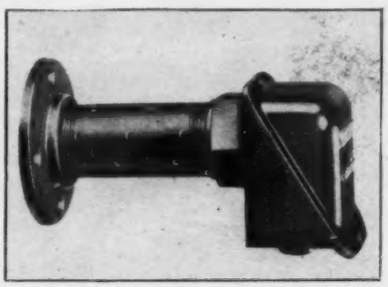
Wedgbelt Pulley Is Easily Adjustable

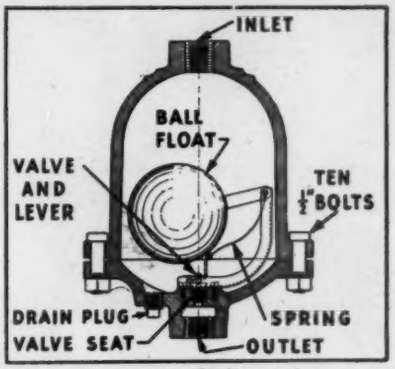
It is necessary only to turn the adjusting screw of the adjustable diameter "Wedgbelt" pulley with a spanner wrench to change the pitch diameter of the pulley. As the adjusting collar is turned, the side walls making up each groove are regulated to increase or decrease the pitch diameter of the pulley. Offered by the American Pulley Co., 4214 Wissahickson Ave., Philadelphia, Pa., these pulleys are designed so that both side walls making up each groove move in or out simultaneously, thus maintaining belt alignment with the grooves in the companion pulley.



"Photo-Head" Detects Stoppage of Flames

Designed for fuels, other than gas, burning with luminous flames the "Photo-Head" introduced by the Wheelco Instruments Co., 1929–1933 S. Halsted St., Chicago, Ill., is an adjunct to the "Flame-Otrol" safeguard. The "Photo-Head" takes the place of the standard electrode and affords instantaneous protection against flame failure. It is sensitive to the characteristics of a luminous flame, but is not responsive to heat radiation from the combustion chamber. In conjunction with the "Flame-Otrol," it shuts down the fuel supply, preventing entry of unburned fuel into the combustion unit to eliminate the explosion hazard.





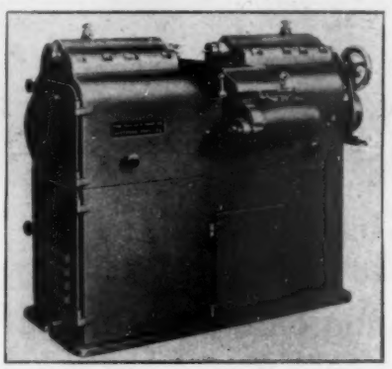
Automatic Trap Has Snap-Action

The Armstrong Machine Works, 893 Maple St., Three Rivers, Mich., has announced the development of an automatic snap-action mechanical trap for draining water from compressed air lines, tanks, separators, and aftercoolers. The principal advantages claimed for this device are immunity to ordinary dirt troubles, ability to discharge water without loss of air, positive opening and closing of discharge valve and freedom from need for priming. Capacity is 1,400 lb. of water per hr. at 125 lb. pressure and 1,000 lb. per hr. at 250 lb.

Spline Miller is Semi-Automatic

Designed to produce accurately deep or shallow keyways on opposite sides of the same piece, or singly on two pieces simultaneously, through slots or similar work, the No. M-80 duplex spline milling machine offered by The Taylor & Fenn Co., 54 Arch St., Hartford, Conn., provides high spindle speeds which adapt it for the use of small diameter cutters. With the exception of loading and unloading the work, the miller is semi-automatic. Setting the cutters for proper depth and adjusting the table for length of cut can be performed quickly.

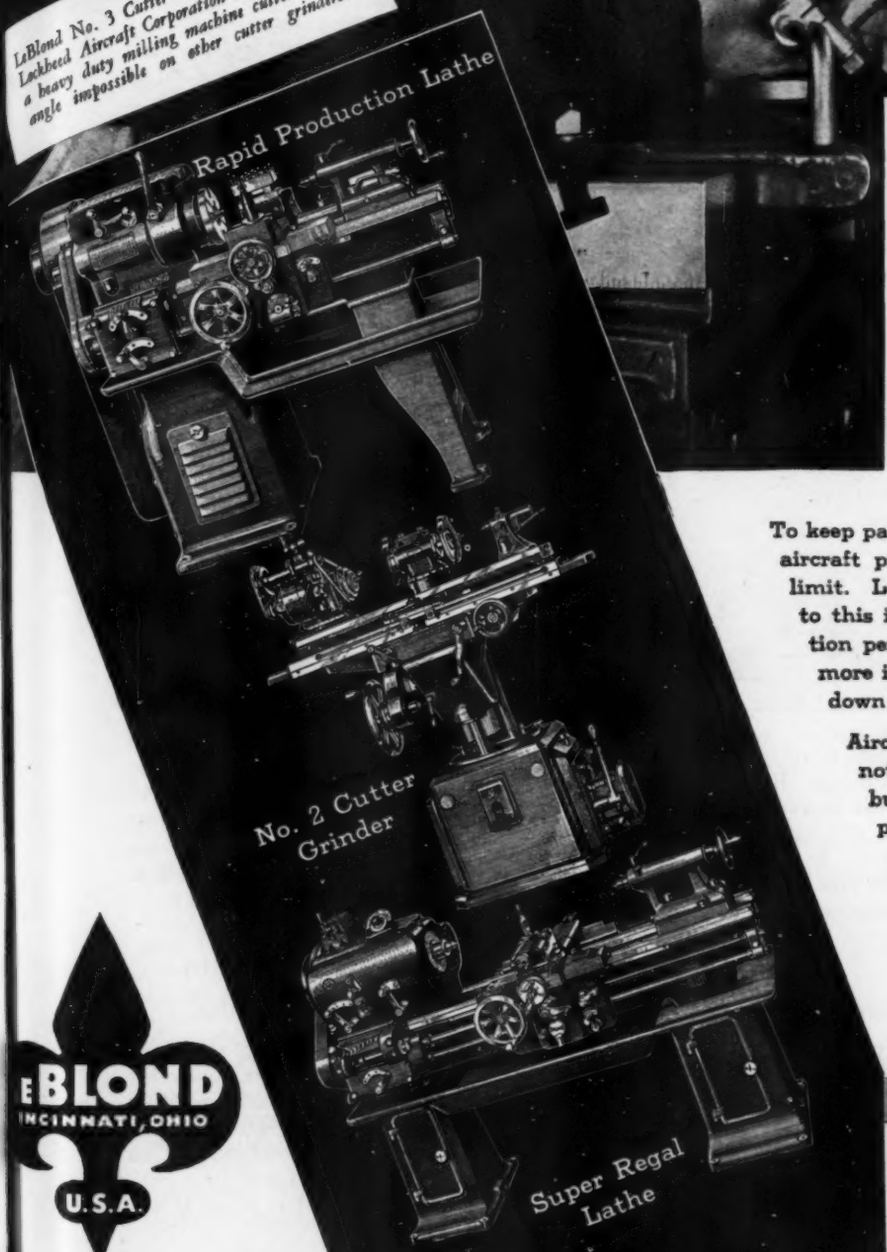
The spindles are mounted in precision double-row ball bearings in sliding quills guided by a hardened key. This method provides effective support for the cutters close to the work and maintains alignment of one spindle with the other. Table travel is controlled by crank action, and a positive method of adjusting the stroke insures close duplication of the length of cut. Depth of cut is controlled by cams inclosed in the machine directly under the quills. Pick-off pulleys provide means of changing the spindle speeds. Table strokes are increased or decreased by the use of pick-off gears.



Specifications: Maximum cutting diameter, $\frac{1}{2}$ in.; cutting lengths, 4 in. plus cutter diameter; cutting depth, both spindles, 4 in.; cutting depth, one spindle, 2 in.; independent spindle adjustment, $1\frac{1}{2}$ in.; distance between ends of spindles, $2\frac{7}{16}$–$9\frac{7}{16}$ in.; spindle speeds, 730, 1,080, 1,600 and 2,385 r.p.m.; spindle feeds, 0.0025 to

Aircraft Industries Depend on

LeBlond No. 3 Cutter Grinder installed at Lockheed Aircraft Corporation . . . grinding a heavy duty milling machine cutter at an angle impossible on other cutter grinders.



LeBlond

LATHES AND CUTTER GRINDERS

For Faster, Lower Cost Production

To keep pace with the Government's rearmament program, aircraft productive capacity must be stepped up to the limit. LeBlond machine tools contribute immeasurably to this increased rate of production. Doubling production per hour is truly LeBlond's achievement . . . and more important, when production goes up, cost comes down just as fast.

Aircraft industry is turning to LeBlond machine tools not only for increased production at reduced cost, but also for performing exacting operations impossible to accomplish on other machines.

LeBlond machine tools—particularly the Rapid Production Lathe, the Cutter Grinders, and the new Super Regal Lathes—are designed for aircraft plants to whom faster production, greater operating efficiency, and wider range capacity means lower production costs.

LEBLOND
CINCINNATI, OHIO
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THE R. K. LEBLOND MACHINE TOOL CO.
CINCINNATI, OHIO

MAIL THE COUPON NOW

R. K. LeBlond Machine Tool Co.,
Dept. H-22, Cincinnati, Ohio.

Please send me full details on your complete line of machine tools that serve aircraft production progress.

Name.....

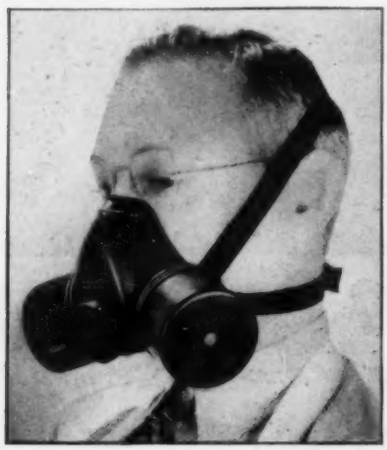
Address.....

City..... State.....

0.020 in.; table speed, 2½ to 67 strokes per min. Distance from top of table to center of spindle, 3½ in.; working surface of table 4 x 24 in.; floor space required, 29 x 54 in.; net weight, 2,225 lb.; motor required, 1½ hp.

Respirator Uses Rubber Face Piece

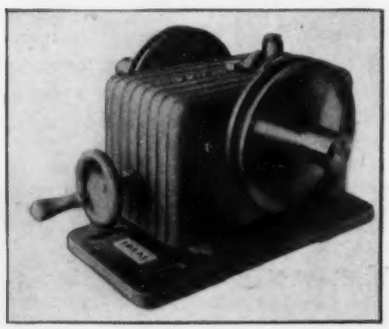
Designated as No. 752L, the low-resistance twin-filter respirator shown provides protection against both Type A and lead dusts. Offered by Willson Products, Inc., 251 Thorn St.,



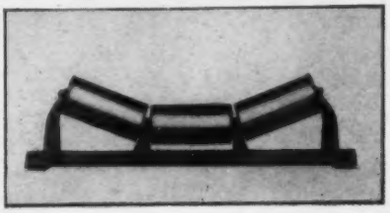
Reading, Pa., this respirator employs a small rubber form-fitting face piece, so designed as to permit the wearing of goggles or spectacles without visual interference. Two "Rotiform" filters, each having 30 sq. in. filtering surface, minimize breathing resistance.

"Ideal" Transmission Has Control Wheel

A series of "Select-O-Speed" transmissions having handwheel control has been announced by the Ideal Commutator Dresser Co., 1057 Park Ave., Sycamore, Ill. These transmissions supplement the standard line of variable speed units which range up to 7½ hp. capacity, and have a lever-type control. The handwheel



control is recommended where finer feed adjustment and smaller increments of speed are necessary.

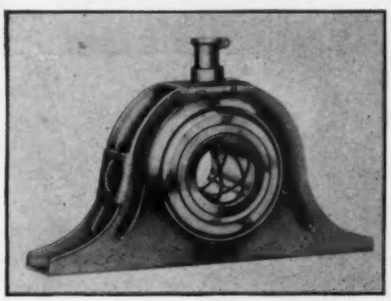


No. 43 Belt Idlers Are Self-Cleaning

Series No. 43 belt idlers, introduced by the C. O. Bartlett & Snow Co., Cleveland, Ohio, have self-cleaning bases. The support brackets are assembled in jigs to assure proper alignment and correct spacing. Slotted holes are provided in the mounting plates to permit the making of slight adjustments in aligning the belt. Idler rolls are machine faced on the ends and pressed onto the shoulders of the cast roll ends, whose outer edges have been rounded and smoothed to prevent injury to the belt.

Steel Pillow Block Has Light Weight

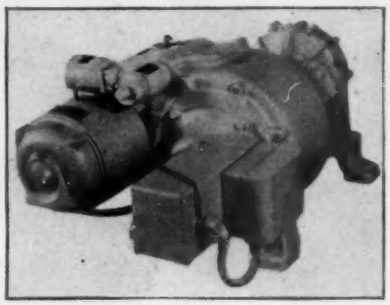
The steel housing pillow block shown consists only of three parts. Offered by the Randall Graphite



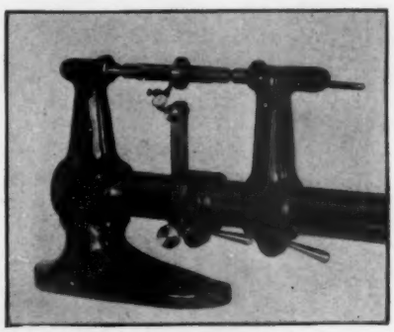
Products Corp., 609-613 West Lake St., Chicago, Ill., this pillow block is available in shaft sizes from ½ to 1 in. and can be mounted in any position. It has large oil capacity and is said to be designed so as to maintain self-alignment and to run quietly.

Sterling Speed Control Operates Automatically

The completely automatic variable speed "Speed-Trol" unit shown provides a 4 to 1 infinite speed variation. It is powered with a 3-hp., three-phase, 1,800-r.p.m. constant speed motor. Position of the small lever on the control box governs the speed of the output shaft. This shaft is mechanically connected to some part of the system which indicates movement of the required speed. The lever travels through an arc of approximately 60 deg. for a complete speed range and is provided with over-travel to



prevent damage to the switch mechanism. Only about 12 oz. in. is required to move the lever. These units have been developed by Sterling Electric Motors, Inc., Telegraph Road at Atlantic Blvd., Los Angeles, Calif.



"Moore" Bench Centers Have 13-in. Swing

The dial gage post on the "Moore" bench centers can be adjusted both in and out and to right or left. These centers will swing pieces up to 13-in. in diameter and up to 36-in. long. Made by Moore Special Tool Co., Bridgeport, Conn., these centers are being marketed by Marburg Bros., Inc., 90 West St., New York, N. Y. Despite the large swing and long length, these centers are claimed not to be top heavy and will not tip over even if not fastened to the bench.

"Endurweld" Chain Is Electric Welded

Temperature of the weld and pressure of the electrodes are controlled automatically in the electric welding process used in the manufacture of "Endurweld" chain developed by the American Chain & Cable Co., Inc., York, Pa. The weld is made at the

end of the link and thus is protected from damage, especially when the chain is used over sharp corners. At present, "Endurweld" chain is fabricated in all standard types of sling chains in which all attachments are made from the same material used in the chain. It also is furnished in continuous lengths.

"Kem Lustral" Enamel Has Wide Application

"Kem Lustral" enamel offered by the Sherwin-Williams Co., 101 Prospect Ave., N. W., Cleveland, Ohio, can be applied to wood or metal surfaces subject to exterior or interior exposure. It can be brushed, sprayed, dipped, air-dried or baked. This enamel is said to produce a smooth mirror-like finish and to maintain its toughness, gloss and color under exposure. It is built around a synthetic resin developed in the laboratories of the Sherwin-Williams Co.

"Vitra-Carlite" Clear Provides Hard Surface

The Hilo Varnish Corp., 42–60 Stewart Ave., Brooklyn, N. Y., has developed "Vitra-Carlite Clear" varnish to provide added luster, toughness and surface hardness for all types of dip work, enameled metal and wood parts, and on bright metal parts which are subjected to considerable heat inside or out. Tests show that one dip baked at 250 F. for 1 hr. produces a clear finish with practically no discoloration of the metal.

TRADE PUBLICATIONS

BENCH LATHES Bulletin No. 505-E, published by Rivett Lathe & Grinder, Inc., Boston, Mass., contains 22 pages of illustrations, descriptions and specifications concerning the Model 505 precision bench lathe and accessories.

CUTTING TOOLS A four-page bulletin issued by the Gorham Tool Co., 14400 Woodrow Wilson Ave., Detroit, Mich., discusses the use of high-speed steel and cemented carbide cutting tools.

GEAR MEASURER An illustrated folder offered by the Fellows Gear Shaper Co., 78 River St., Springfield, Vt., describes its new involute measuring machine.

HEADERS Bulletin No. 783-A, issued by the Waterbury Farrel Foundry & Machine Co., Waterbury, Conn., provides specifications of a line of solid die double stroke "Hi-pro" headers.

INSTRUMENTS Bulletin No. 150, issued by the Wheelco Instruments Co., 1929 S. Halsted St., Chicago, Ill., outlines features of a recently developed recording thermometer.

LATHES "The Sebastian Salesman," a 16-page illustrated bulletin offered by the Sebastian Lathe Co., Cincinnati, Ohio, outlines various steps in lathe manufacture.

LIGHTING A folder released by J. Zagora Machine & Gear Co., Charlotte, N. C., discusses installations of the "Zig" localized lighting unit for machine tool and other industrial applications.

LUBRICATION Catalog No. 75, released by Bowen Products Corp., Auburn, N. Y., describes a centralized "hydraulic automatic" high-pressure lubricating system.

MILLING ATTACHMENTS A 8-page illustrated bulletin issued by Bridgeport Machines, Inc., 52 Remer St.,

Here's the ideal "Mike" for your production work. You can give it plenty of hard use and need never doubt its accuracy. The frame is extra sturdy though comparatively light weight and the action is as smooth as velvet. The Lufkin system of markings gives accurate, positive readings at a glance and the exclusive adjustment features let you permanently retain the tool's original accuracy. Made in sizes from 1 to 12 inches. Send for Precision Tool Catalog No. 7.

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THE LUFKIN RULE CO.
SAGINAW, MICHIGAN

Canadian Factory
WINDSOR, ONT.

TAPES — RULES — PRECISION TOOLS

Bridgeport, Conn., describes and illustrates features of a line of high-speed milling attachments.

MILLING MACHINES A leaflet now being distributed by Bridgeport Machines, Inc., 52 Remer St., Bridgeport, Conn., provides specifications of a turret milling machine and master milling unit.

PHOSPHOR BRONZE The Riverside Metal Co., Riverside, N. J., has published a 48-page illustrated catalog dealing with many applications of phosphor bronze. Included are many examples illustrating its wide versatility, detailed specifications regarding composition and physical properties, and listings of many stock products made of this material.

PRECISION LATHES Bulletin No. 183, published by the Monarch Machine Tool Co., Sidney, Ohio, contains 32 pages of illustrations and descriptions of the features of the new 10x20-in. sensitive precision lathe.

RIVETING EQUIPMENT Bulletin No. R-1A, published by the Tomkins-Johnson Co., Jackson, Mich., describes several applications of "Rivitors" in the aircraft industry.

ROLL GRINDERS Bulletin No. G-427, published by Cincinnati Grinders, Inc., Cincinnati, Ohio, provides 12 pages of specifications and illustrations concerning a line of 36, 44, 50 and 60-in. traveling wheel head roll grinding machines.

RUST PREVENTION A 40-page illustrated bulletin published by the Parker Rust-Proof Co., Detroit, Mich., provides detailed information concerning the "Bonderizing" rust prevention process.

STIFFNESS GAGE Tabor Instrument Co., North Tonawanda, N. Y., discusses the Model V-5 stiffness gage for use with paper, light sheet metal and wire in Bulletin No. 3802.

THREADING Three circulars published by the Waterbury Farrel Foundry & Machine Co., Waterbury, Conn., provide up-to-date information on several pieces of threading equipment. Circular No. 829-A-3 contains 16 pages dealing with screw thread rolling machines, No. 902-A contains 8 pages regarding chain-feed screw thread rolling machines, while No. 907-A-2 provides four pages of specifications regarding an automatic high-speed nut tapping machine.

TOOLS "Gear Cutting Tools," a 32-page booklet released by the Michigan Tool Co., 7171 E. McNichols Road, Detroit, Mich., includes information for selecting the right tools for the job, estimating time, sharpening tools and selecting cutting speeds.

TURRET LATHES Features of the Nos. 5 and 7 turret lathes are discussed in a 12-page bulletin issued by Bardons & Oliver, Inc., W. 9th St., Cleveland, Ohio.

TRUCKS Bulletin No. 38-G, published by the Nutting Truck Co., 1153 W. Division St., Faribault, Minn., illustrates features and provides specifications of an extensive line of hand trucks.

VALVE DISKS A pamphlet issued by the Goetze Gasket & Packing Co., New Brunswick, N. J., discusses an improved valve disk for renewable-disk type valves.

WRINKLE FINISHES Data sheets giving technical information on wrinkle finishes are now being distributed by Maas & Waldstein Co., 438 Riverside Ave., Newark, N. J.

HERE'S THE BEST COMBINATION *for* MAXIMUM MACHINABILITY *at* HIGHER SPEEDS

WYCKOFF
LEADED STEELS

Production records prove conclusively that Wyckoff Leaded Steels will machine better and at much higher speeds than any of the well known standard analysis steels. Futhermore, it has been definitely determined that the addition of lead does not affect the physical properties of the steel.

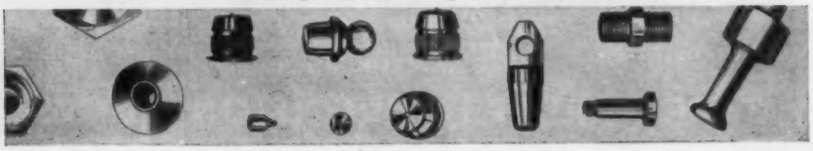
All regular S A E grades, both Open Hearth and Bessemer Steel are available to meet your specific conditions.

Data covering the characteristics and advantages of these leaded steels will be gladely sent on request. Would you like to have samples for tests runs in your shop?

WYCKOFF DRAWN STEEL COMPANY

FIRST NATIONAL BANK BLDG., PITTSBURGH, PA. 3200 SO. KEDZIE AVENUE, CHICAGO, ILL.

Mills at Ambridge, Pa. and Chicago, Ill. . . . Warehouse Stocks in Principal Cities . . . Manufacturers of Carbon and Alloy Steels . . . Leaded Steels . . . Turned and Polished Shafting . . . Turned and Ground Shafting . . . Wide Flats up to 12" x 2"



SEEN and HEARD

JOHN R. GODFREY

Honing or Lapping

Chrysler's "Superfinishing" process has stirred up a lot of interest and discussion. This is not confined to the results but extends to whether the operation is honing or lapping. One pronouncement by one abrasive expert insists that it is honing, because in his opinion the term lapping is reserved for operations using a loose, or paste abrasive. This opinion ignores the fact that some, if not all, of our early lapping was done with copper or iron disks charged with diamond dust or other hard abrasive.

While stones are used in superfinishing, as in commercial honing, they are of extremely fine grit and resemble laps both in this respect and because of the small amount of metal removed.

Hard Facing Again

More and more applications of hard facing are continually coming to light. Gripper jaws for holding composite brake drums in welding last five times as long as before. Chuck jaws or clutch fingers in automatic screw machines are helped in the same way. Diesel engine valves with hard faces recently made a round trip from England to Java without stopping to change valves as is usual on this run. There are probably few plants that do not have more than one place where money can be saved by hard facing certain wearing points.

Significance of Welding

By J. F. LINCOLN
President, The Lincoln Electric Company

In every generation one or more mechanical developments occurs which tremendously affect the lives of those living in that generation. Obviously, the steam engine which began the industrial age changed fundamentally the whole life and outlook of all people at that time. In more recent years the telegraph and the telephone did the same thing. In our own generation the presence of the automobile has made life an entirely different thing than it was before. Radio, more recently, still is profoundly affecting the lives, thoughts and outlook of every citizen.

The mechanical development of the last fifty years was greater than that of all time prior to 1890. It is to be expected that the development of the next fifty years will be even greater so that the habits and lives of our children, when they become our age, will be radically different than ours in the same way that ours has been different from that of our parents.

One of the things which is going to have great effect in this revolution is the use of arc welding. This process has made it possible to manufacture many structures which heretofore have been impossible. Also, it has decreased the cost of many devices previously made by other methods and it has reduced the weight and increased the reliability of many of these devices. How profound this effect is can be judged by the results of the competition run last year by the James F. Lincoln Arc Welding Foundation. These papers showed new applications of arc welding, since only those were considered, which would make a saving of $1,600,000,000 if the structures outlined in the papers submitted had been made by this method.

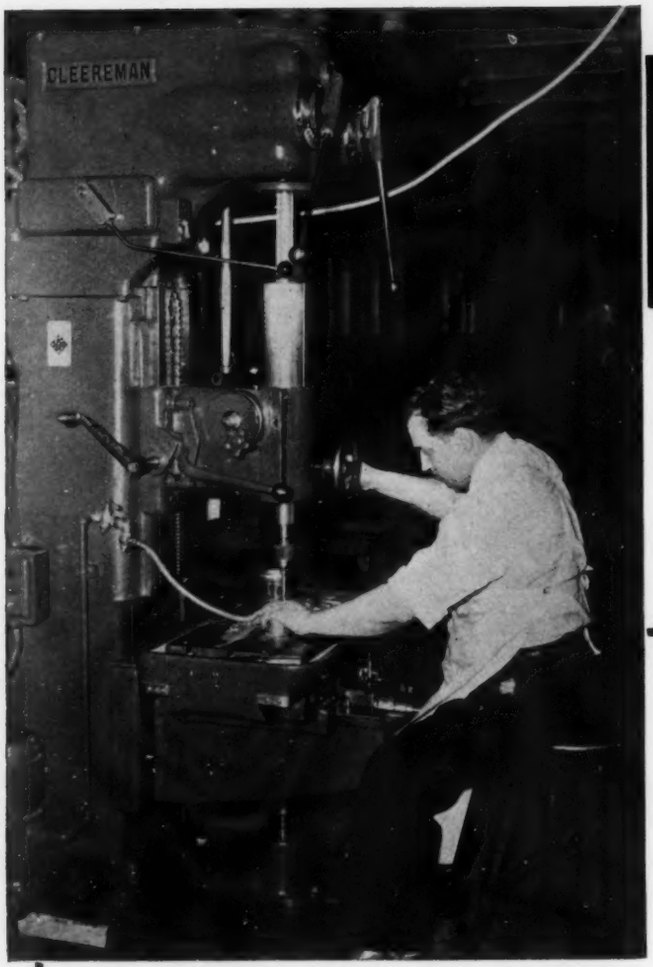
Briefed from an address before the Los Angeles Chamber of Commerce on January 23, 1939.

SET UP TO DRILL AIRPLANE PARTS

WITH A SUPER SERVICE UPRIGHT

Pratt & Whitney Aircraft sets high standards for the equipment to be used in its shop.
The choice of a Super Service Upright for the exacting demands of the tool room in this modern shop is significant of the fact that this machine is not only adaptable to a wide range of work but also that it can be depended on to meet close tolerances.
Super Service Uprights are available in several sizes and insure convenience, stamina, accuracy and all-round high production efficiency. For details ask for a copy of Bulletin U-22.

THE CINCINNATI BICKFORD TOOL CO.
OAKLEY CINCINNATI OHIO U.S.A.



CLEEREMAN

MEETING SPRINGFIELD ARMORY'S DEMAND FOR ACCURATE DRILLING

This new 25" CLEEREMAN DRILLING MACHINE is a valuable addition to the tool room in the Hill Shop of the Springfield Armory. Here we see it drilling a 5/16" hole in a steel forging at a spindle speed of 825 r.p.m.

CLEEREMAN DRILLING MACHINES are available in a standard range of sizes from 21" to 30" and in capacities up to 1½" in S.A.E, 1035 steel. They are fast, accurate, convenient and pay for themselves through more and better work at lower cost.

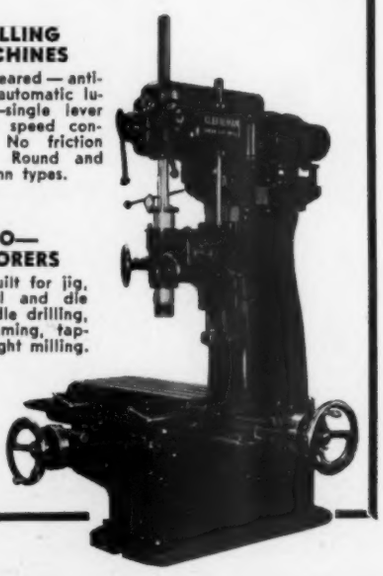
Call in our engineers to analyze your drilling operations and to offer practical suggestions for handling your work at savings over your present methods.

DRILLING MACHINES

Fully geared—anti-friction—automatic lubrication—single lever feed and speed controls. No friction clutches. Round and box column types.

ALSO— JIG BORERS

Precision built for jig, fixture, tool and die work. Handle drilling, boring, reaming, tapping and light milling.



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REPRESENTED BY DEALERS IN PRINCIPAL CITIES

FINE SPRING STEEL—IN NARROW WIDTHS TO MEET EXACTING NEEDS

Can you tell fine spring steel by the "feel" of it? If so, you would enjoy flexing the Roebling Cold Rolled "Flat" shown above. It is one of the many high quality flat wires we make to exacting specifications.

This particular spring steel combines great strength and pliability. Its temper is uniform and held within close limits. Its surfaces and edges are free of defects. Finish—tempered, polished, and blued.

Making high quality cold-rolled high carbon and low carbon steel flat wire is a specialty with us—and we have the long experience and the unusual facilities necessary to handle this type of work.

May we help you with your difficult flat wire problems? Send us your specifications and we will gladly furnish recommendations, samples, and prices.

JOHN A. ROEBLING'S SONS COMPANY
Trenton, N.J. Branches in Principal Cities

TYPES:—Roebling Cold Rolled Flat Wire is made from both high carbon and low carbon steels, produced in Roebling's own mills. The high carbon flat wire is available in tempered and untempered types.

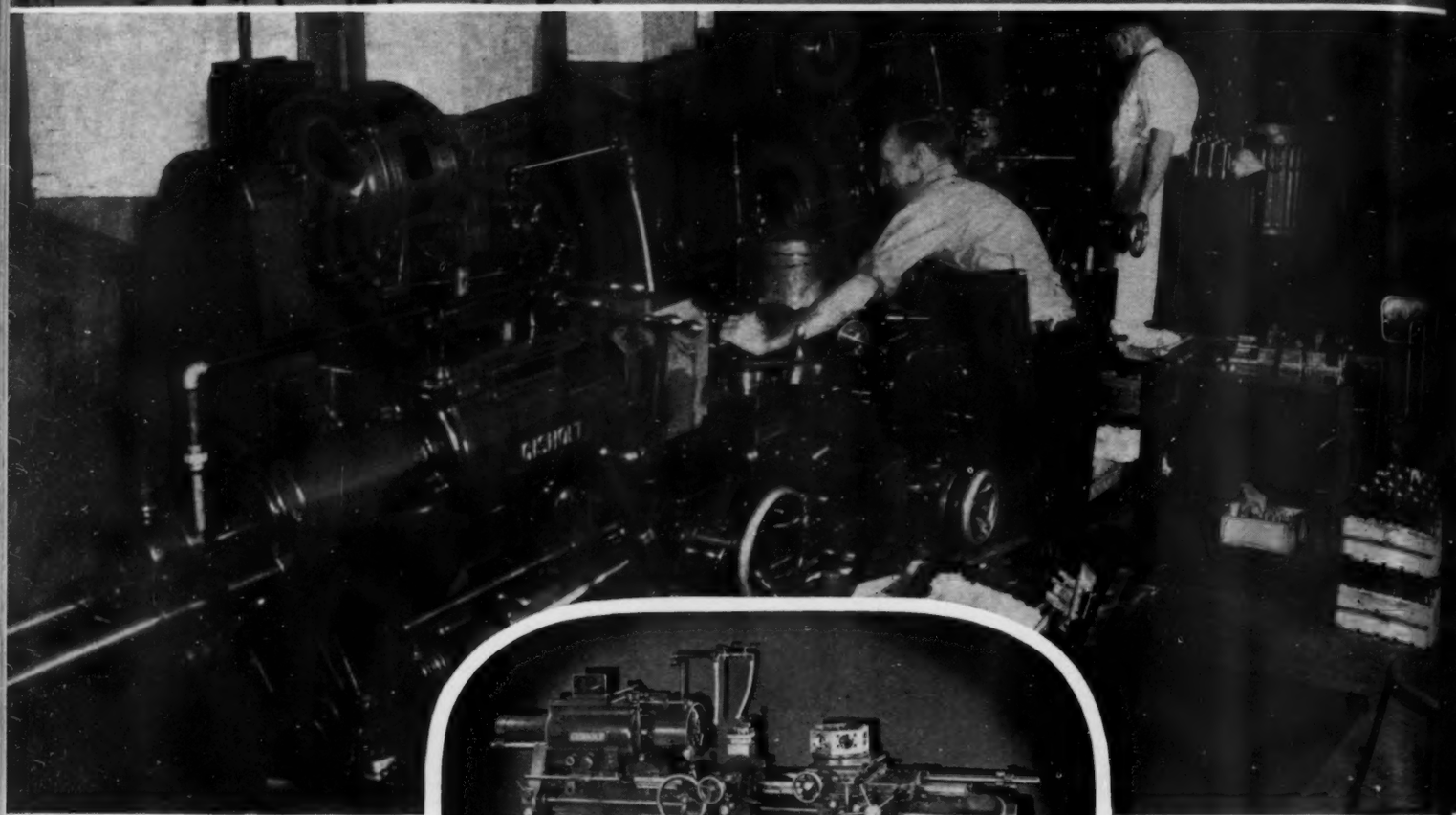
FINISHES:—bright, black annealed, bright annealed, tinned, japanned, galvanized, blued, straw-colored, and coppered.

JAR

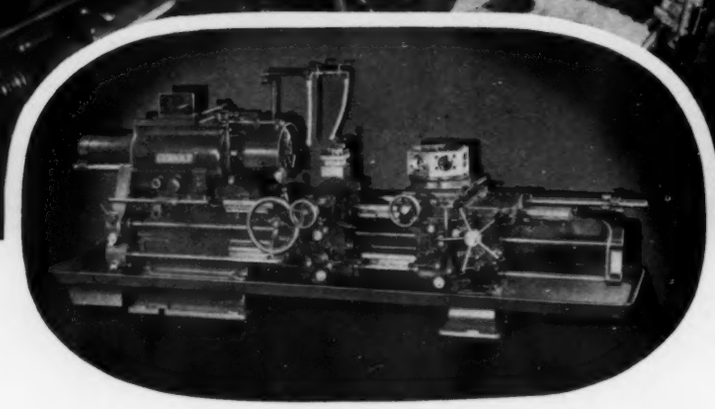
COLD ROLLED STEEL FLAT WIRE—TO MEET EXACTING REQUIREMENTS

THE ARMY

SPEED UP



Gisholt High-Production Turret Lathes are made in 3 sizes, with bar capacity ranging from 2½" x 26" to 4½" x 48"; chucks from 12" to 18", swing from 19" to 26¾".



The Gisholt cross-feeding hexagon turret employs simple tools which reduce set-up time to a minimum.

FOR FAST MACHINING OF SMALL PARTS

Here, at the Hill Shop of Springfield Armory, a battery of Gisholt Model L High Production Turret Lathes are setting production records in the machining of small stainless steel parts for rifle and gunwork.

Gisholt High Production Turret Lathes are ideal where the job calls for large volume and where parts are machined to close limits and a high finish. In many branches of the metal working industry, the increased production with these new Gisholts has been great enough to pay for themselves in only a few months. These savings may be possible in your own plant. Why not investigate? Shall we send literature?

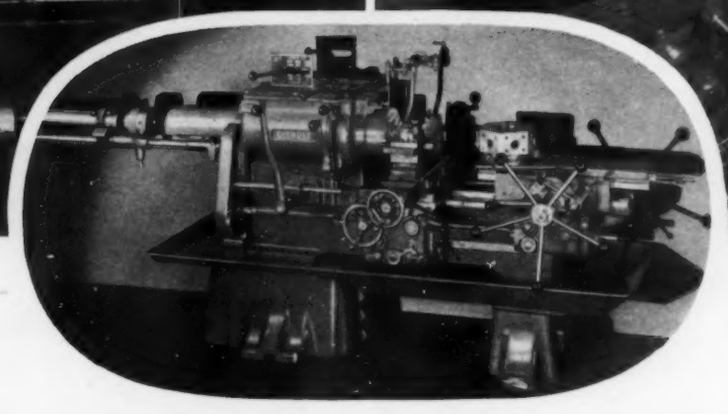
GISHOLT

GISHOLT MACHINE COMPANY

1201 EAST WASHINGTON AVENUE, MADISON, WISCONSIN, U. S. A.

TURRET LATHES • AUTOMATIC LATHES • TOOL GRINDERS • BALANCING MACHINES

Y THE NAVY
UP WITH GISHOLTS



Gisholt Universal Ram Type Turret Lathes are ideal for the manufacturing of miscellaneous parts.

Gisholt Universal Ram Type Turret Lathes are built in 3 sizes, with bar capacity from 1½" x 10" to 2½" x 14"; chuck sizes from 8" to 15".

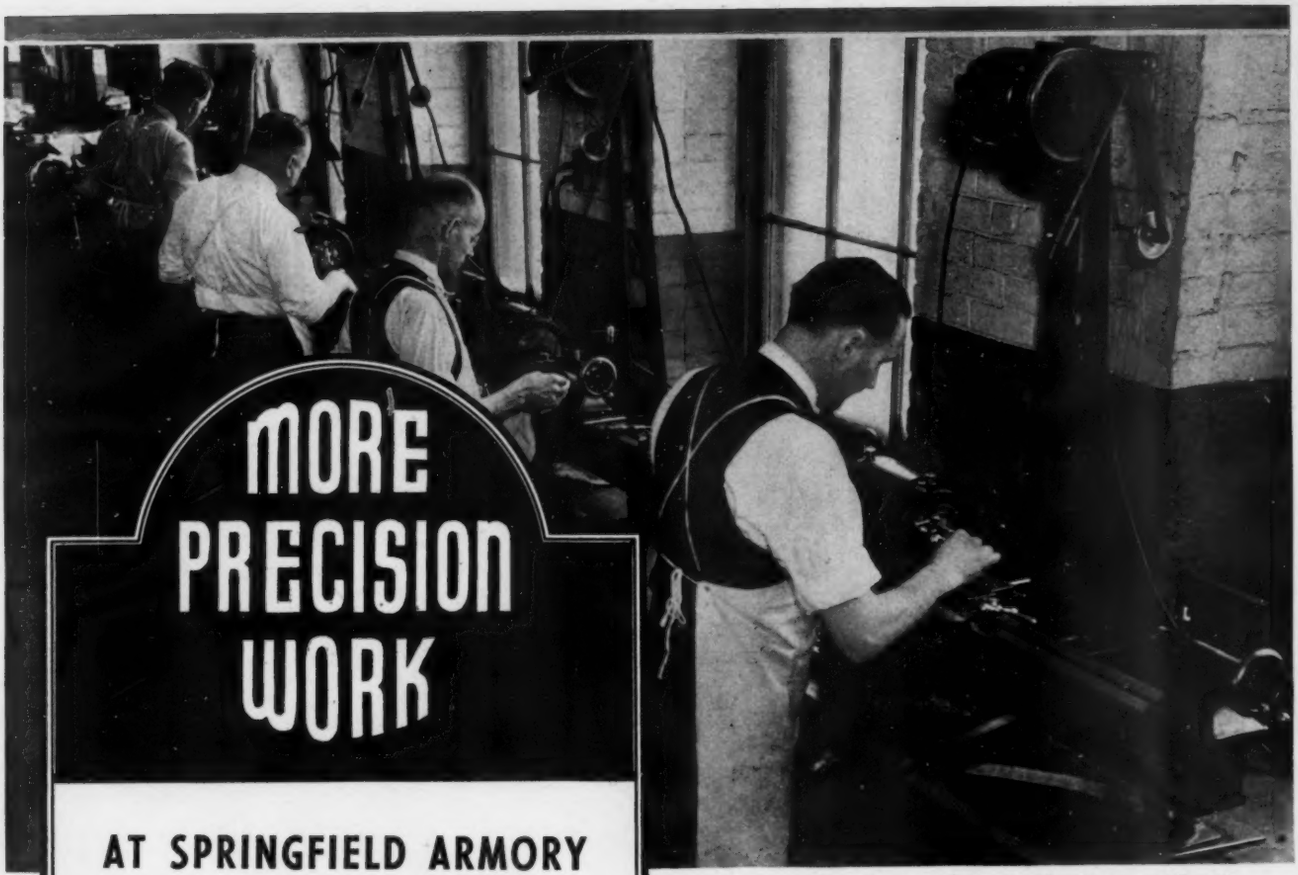
QUICK CHANGE-OVER FOR A WIDE VARIETY OF WORK

This Gisholt No. 5 Universal Ram Type Turret Lathe, in navy work, is machining 1" stainless steel bar stock with spindle speeds of 163 r.p.m. and .031" feed.

These Gisholts are fast, of course! But even more important is the quick and easy change-over of tool set-up for handling a wide variety of work. This versatility gives Gisholt Turret Lathes the preference. The quickest way to find out what they can do to speed up production and save money in your own plant is to call in a Gisholt engineer.

Among the outstanding features of Gisholt Turret Lathes are hardened steel ways and extremely rigid construction which permit multiple cutting. Newest of Gisholt's developments is the "Speed Selector," which provides selective automatic speed changes—increases production as much as 50%. Simpler operation, greater speed and lower cost make it a matter of sound economy to replace older machines with new Gisholts. Write for catalogs.

GISHOLT MACHINE COMPANY
1201 E. Washington Avenue • Madison, Wisconsin



MORE PRECISION WORK

AT SPRINGFIELD ARMORY

Fulfilling the reputation of Rivett machines for MORE PRECISION WORK, a large battery of Rivett enclosed head, high speed bench lathes are used in precision production on small rifle parts. The ease of set-up, the high spindle speeds and the variety of attachments make possible a wide range of accurate manufacturing operations.

There are correct Rivett bench lathes for every use as they are furnished in all sizes with bronze, ball or Timken roller spindle bearings.

Grinders are also designed for precision toolmaking and accurate manufacturing. With interchangeable spindles for internal and external grinding they likewise are always ready for MORE PRECISION WORK.

Write for detailed bulletins

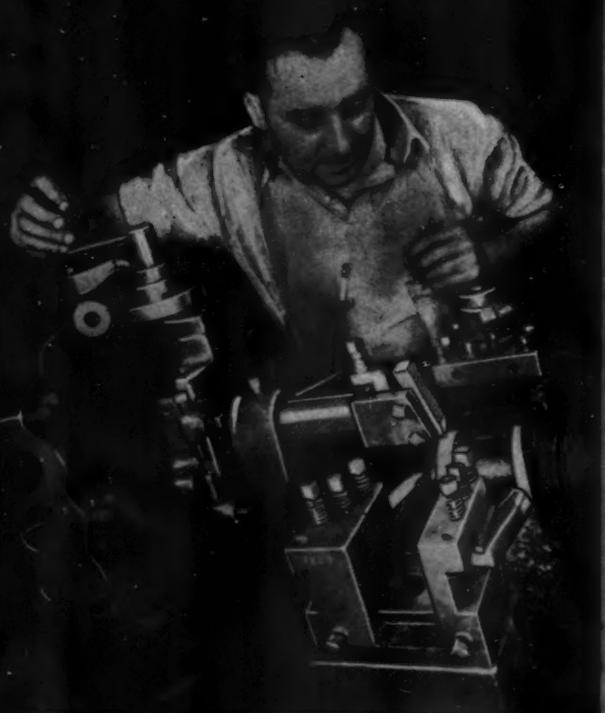
Battery of Rivett Bench Lathes in production on small parts for rifles. Other Rivett Lathes are in use throughout the Armory's modernized shop.

One of several Rivett Internal Grinders used on precision work in the Springfield Armory toolrooms.

RIVETT LATHE & GRINDER INC.
BRIGHTON, BOSTON, MASS.

SENSATIONAL machining performance with CRUCIBLES

New REXALLOY



PRODUCTION increases of 100% and higher . . . greater speeds and longer life . . . have been attained with the new non-ferrous cutting Alloy REXALLOY, in comparative tests with similar materials!

With its basic elements of Cobalt, Chromium and Tungsten accurately balanced and controlled—REXALLOY has such a high degree of hardness at elevated temperatures that it is practically unforgeable and is cast in Tool Bit form. Hardness and structural stability at extreme temperatures is indicated by the fact that only a one point drop in hardness on the Rockwell C scale is occasioned after exposure to the terrific heat of 2,000°F! Conclusive tests also show REXALLOY to possess greater resistance to abrasive wear than any other cast tool material available.

In your plant—REXALLOY Tool Bits undoubtedly offer money saving advantages in increased turning speeds and lowered unit tool costs! Thus, why not call or write your nearby Crucible Branch Office for a representative to give a demonstration of REXALLOY'S superior performance on your machines. If you prefer, the complete story on REXALLOY . . . the latest member of the Rex family is contained in an informative booklet RE-55. It is yours for the asking. Write for your copy today!

CRUCIBLE STEEL COMPANY of America

Specialty Steelsmiths to INDUSTRY

CHRYSLER BUILDING • 405 LEXINGTON AVENUE • NEW YORK CITY
BRANCHES, WAREHOUSES AND DISTRIBUTORS IN PRINCIPAL CITIES

CONSULT TELEPHONE DIRECTORY OR THOMAS' REGISTER FOR NEAREST OFFICE

MAKERS OF HIGH SPEED, TOOL, STAINLESS, ALLOY, PRODUCTION AND SPECIAL PURPOSE STEELS

EXTENDING THE FRONTIERS
of
Precision Surface Grinding

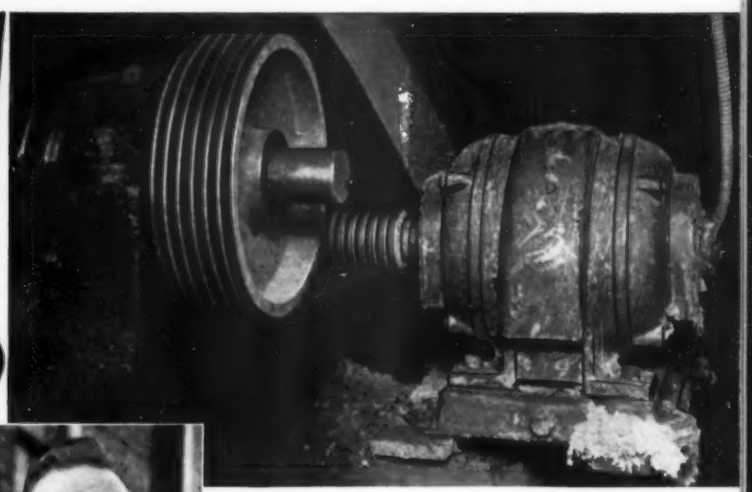
Once in a blue moon a really *new* machine tool is developed—one which extends man's horizon, widens his field of accomplishment. Such a machine is the new Taft-Peirce No. 1 Precision Surface Grinder. Not merely another surface grinder, it is a new and different type of machine—new in its ability to produce surfaces which are really *flat* within extremely close limits of tolerance not heretofore easily attainable, new too in the long years of life which its hardened ways and ball mounting assure, new again in its effortless operation, entirely unique in its tilting wheelhead which makes the surface grinder available for difficult angle and shoulder work.

If you have a problem in maintaining the accuracy of your small surface grinders, if you are interested in extending your frontiers of readily available precision . . . *write us for Bulletin SGA.*

THE TAFT-PEIRCE MFG. CO.

WOONSOCKET RHODE ISLAND

HOW TEXROPE DRIVES PROVED THEY COULD TAKE IT IN A RAINSTORM OF PULP!



Another true case history from the Allis-Chalmers files that proves **"IT PAYS TO BUY THE EQUIPMENT THAT PAYS FOR ITSELF!"**

THE TEXROPE DRIVE and Allis-Chalmers Lo-Maintenance Motor soon looked like this under the continuous rain of pulp at the Tennessee Paper Mills, Chattanooga! But they kept on running . . . through the same pulp and vibration difficulties that had stopped other drives!

L. T. Murphy, Plant Superintendent of the paper mills, says—"Texrope Drives are helping to keep our operating costs down."

Large Paper Company Solves Its Slippage Problems with Allis-Chalmers Texrope Drives . . . Eliminates Vibration Losses! Get the Story of Texrope's Low-Cost Performance...of the Big Savings it Means to You!

If you have perplexing power transmission problems . . . if you are the kind of operator who wants outstanding performance from your drives even when the going gets tough . . . then you'll want to find out how Allis-Chalmers Texrope Drives can give you that kind of performance and save you money at the same time!

Here's what happened at the Tennessee Paper Mills, Chattanooga! They had drive problems . . . plenty of them! A continuous rainstorm of pulp fell on the belts . . . made them wet . . . slippery . . . inefficient! Other methods of power transmission were tried . . . and they, too, failed!

Switched to Texrope!

Then . . . they switched to Texrope Drive! But let L T. Murphy, superintendent of the plant, tell you what happened —

"We were frankly skeptical that we could find any drive that would operate our four vibrating paper stock screens completely satisfactorily. In February, 1938, we ordered a 3 hp Allis-Chalmers Motor and Texrope Drive. We were immediately pleased to find that the vibration and rain of pulp made no difference to the new drive's efficiency.

"In June, we ordered two more motors and drives; and in December ordered the one remaining screen to be equipped with Allis-Chalmers motor and Texrope Drive. We find they operate perfectly even under these conditions and they are helping to keep our operating costs down."

That's the kind of performance thousands of industrial organizations are getting today with Allis-Chalmers Texrope Drives. And that's the kind of performance you'll get! When you use Texrope Drives, you get a smoother, more positive drive . . . long life . . . reduced operating costs!

Save Money with Texrope!

Texrope Drives are available for practically all industrial needs between ¼ hp and 2,000 hp. Call or write the Allis-Chalmers district office near you for complete Texrope information. Let a Texrope-trained engineer help you improve your plant efficiency . . . lower your costs!

Vari-Pitch Speed Changers • Texrope V-Belts • Duro-Brace Texsteel Sheaves • Vari-Pitch Sheaves • Standard Cast Iron Sheaves • Adjustable Pitch Diameter Texsteel Sheaves • 2-3-4 Combination Sheaves • Straitline Automatic Motor Bases • Oil Field Drilling Rigs

Belts by Goodrich

TEXROPE DIVISION

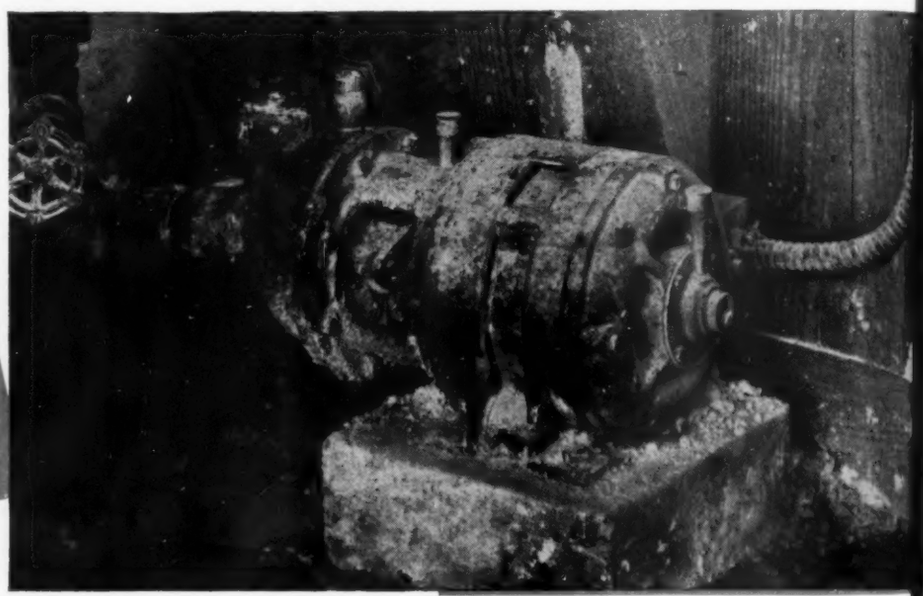
ALLIS-CHALMERS

MILWAUKEE-WISCONSIN

1087

NO PLACE FOR WEAKLINGS!

Here's an Amazing True Story of How 17 Allis-Chalmers Lo-Maintenance Motors Proved Their Low Maintenance Costs! Get the Facts on Full Measure Protection in Lo-Maintenance Motors, on the Savings It Means to You!



Another true case history from the Allis-Chalmers files that proves **"IT PAYS TO BUY THE EQUIPMENT THAT PAYS FOR ITSELF!"**

Operating where dust filled the air . . . fine chemical dust that bit like acid . . . that's a cruel test for any motor to pass! But it's the kind of test that brings out motor differences that might otherwise take months of normal operation to show up! And it's the kind of test that gives Allis-Chalmers Lo-Maintenance Motors a chance to prove their Full Measure Features!

There were 39 motors on the job in this large Southern chemical plant — 17 Allis-Chalmers and 22 of six other makes. All were operating under the same adverse conditions. But here's what the officials of the chemical company discovered when they checked repair and maintenance costs after two years of service!

For the 22 motors of other makes, the total upkeep cost was more than $500.00! But for the 17 Allis-Chalmers motors, the total repair bill was the sensationally low figure of $17.30!

Orders 18 More!

That's the reason this company ordered 18 additional motors . . . made Allis-Chalmers first choice in their plant! And that's the reason Lo-Maintenance Motors are fast becoming first choice in hundreds of plants throughout the country!

For when you buy a Lo-Maintenance Motor, you get more than a motor that delivers just a rated horsepower. You get a motor that has built into it the results of Allis-Chalmers' 90 years of advancing with industry . . . of making motors to meet the rigid requirements of their own famous line of heavy duty industrial equipment.

LOOKS BAD, DOESN'T IT? BUT THIS Allis-Chalmers Lo-Maintenance Motor—like the rest of the original 17 in this chemical plant — is still running as perfectly as the day it was installed . . . giving dependable daily service in motor-ruining chemical dust.

High carbon steel frame . . . indestructible rotor . . . husky all-around construction with no skimping materials . . . add them together and you get a motor that's built for long life . . . without running up costly repair bills!

Get the Full-Measure story on Lo-Maintenance Motors. Call the nearest Allis-Chalmers district office or write direct to Allis-Chalmers. Find out how you can cut maintenance . . . keep production steady . . . with Allis-Chalmers Lo-Maintenance Motors!

MOTORS FOR ALL APPLICATIONS FROM ½ HORSEPOWER AND UP

ELECTRICAL DIVISION

ALLIS-CHALMERS

MILWAUKEE · WISCONSIN

1030

. . . letters that spell "IT SAVES US MONEY"

● These "bouquets" from a few users of the *"Shield-Arc Jr."* in one district, express a sentiment that is the same the world over regarding this low-priced Lincoln d. c. welder. A typical statement is, "Our Lincoln Welder has paid for itself out of savings in one month's time. It is the most profitable tool in our shop."

Investigate the New *"Shield-Arc Jr."* (illustrated above). Its "Job Selector" and Current Control are Self-Indicating and continuous in operation, simplifying welding and assuring maximum welding speed and quality for lower costs. Available in ratings of 75, 100 and 150 amps. Priced exceptionally low. Consult the nearest Lincoln office or mail the coupon today for details.

LINCOLN

LARGEST MANUFACTURERS OF ARC WELDING EQUIPMENT IN THE WORLD

THE LINCOLN ELECTRIC COMPANY
Dept. A-593, Cleveland, Ohio

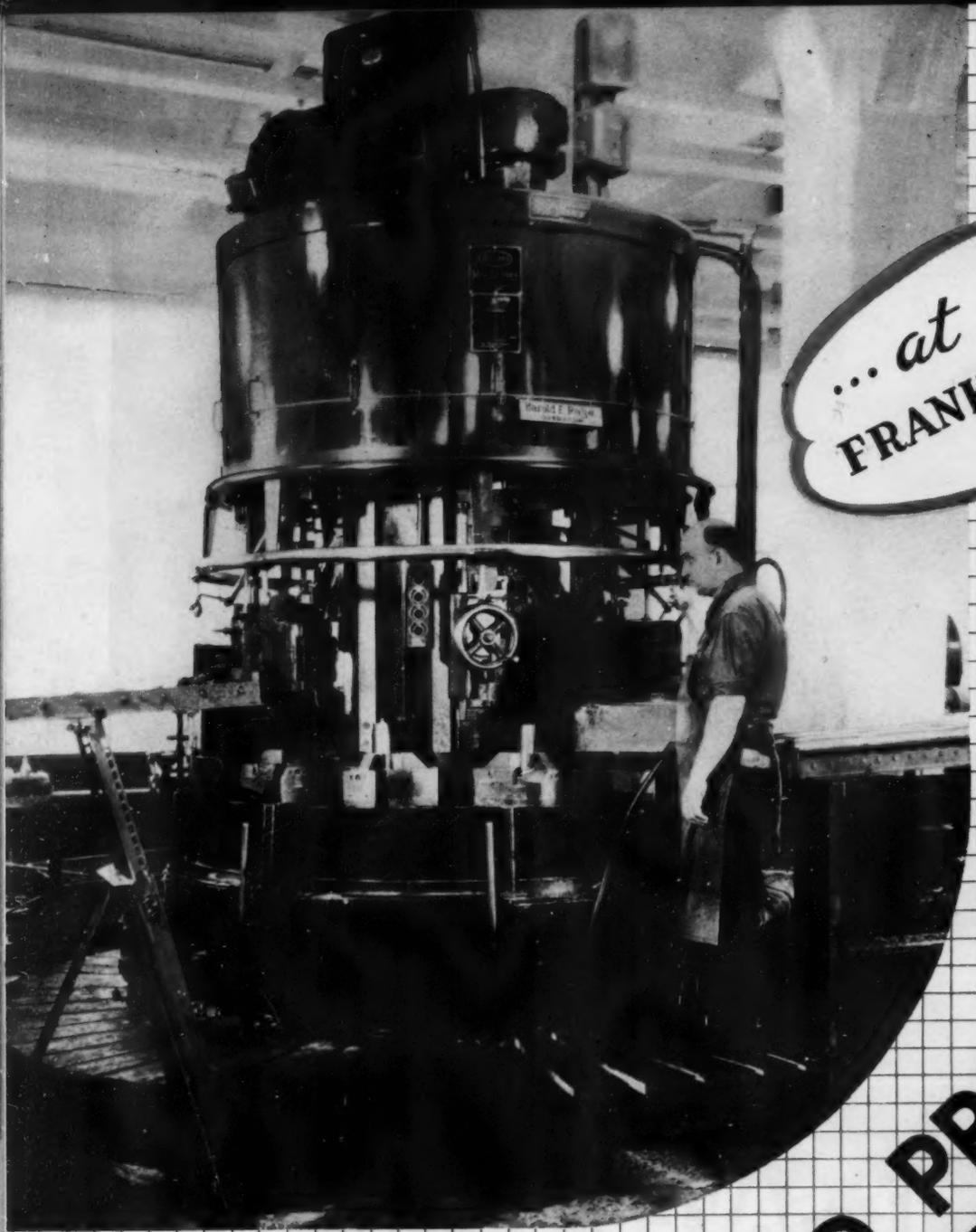
We now use (check which) ☐ arc ☐ gas ☐ none.
Send bulletin on New *"Shield-Arc Jr."*

Name _____ Position _____

Company _____

Address _____

City _____ State _____



... at FRANKFORD ARSENAL

BULLARDS SPEED PRODUCTION

This Bullard Mult-Au-Matic—in the Frankford Arsenal—is used for facing and threading operations on shells of various sizes. On this machine, each piece has two machining cycles—first and second chucking—one end being worked in one circuit and the other end in the next circuit.

THE BULLARD COMPANY

...FOR NATIONAL DEFENSE

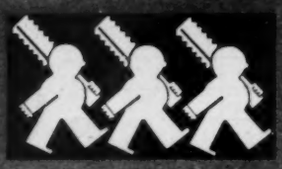
...at PRATT & WHITNEY

THE use of Bullard Mult-Au-Matics and Vertical Turret Lathes in the production of ordnance materials and aircraft is evidence that modernization of production methods is not confined to shop manufacturing machines and equipment for Industrial use only. With Bullards on the production lines of plants engaged in carrying on an extensive program of National Defense, boring, turning, facing, drilling, reaming, and threading operations are stepped up to keep pace with other operations involved in production.

A few examples are shown here of Bullards in action, doing their bit for Uncle Sam, profitably and accurately. Bullards will do the same for you. Ask Bullard Engineers to show you how.

These views show a close-up of the work and a battery of Bullard Vertical Turret Lathes in the Pratt & Whitney Aircraft plant, where they are used for turning, boring and facing engine castings.

BRIDGEPORT, CONNECTICUT



WINTER QUALITY

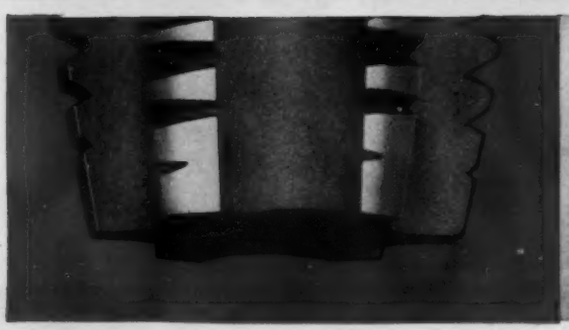
IT HAS ALWAYS been the aim of the Winter Brothers to make the very best possible threading tool, believing as they do that the art of thread cutting is a vital factor in the progress of this fast moving mechanical age.

CONSISTENT with this aim, only the very best of materials and the most skillful craftsmen have been employed. Yet Winter Brothers quality products cost no more than ordinary tools. Based on production records they are surprisingly economical, producing fine threads long after you would expect to discard them.

THE WINTER BROTHERS CO.

MAIN FACTORY: WRENTHAM, MASS.
BRANCH FACTORY: DETROIT, MICH.

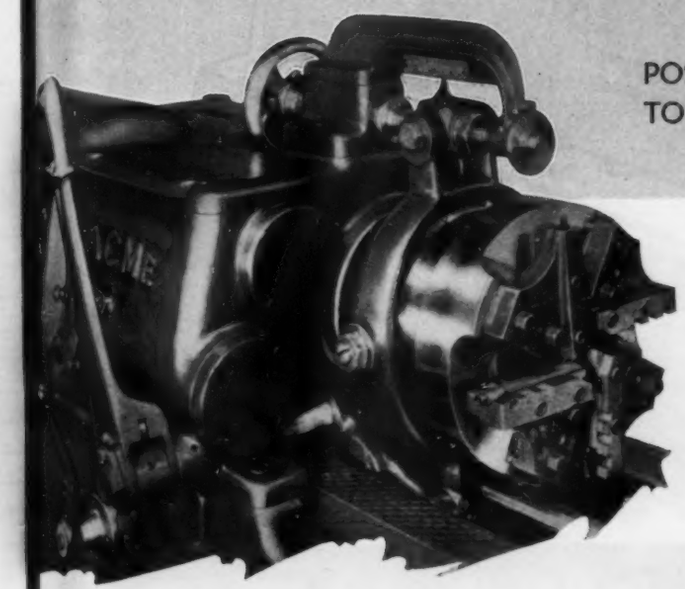
WINTER TAPS



Division of the
National Twist Drill & Tool Co.
Detroit, Michigan

ACME "XL" THREADING MACHINES

HAVE A RUGGED ALL-GEARED DRIVE



● Simplicity and ruggedness of design has been a characteristic of ACME machinery for half a century, and it is characteristic of the new ACME XL Threading Machines today. It is seen in the provision for eight speed changes in virtually geometric progression in the self-contained, quick-change, selective-type gear train shown above. Wide faced, large diameter gears insure minimum tooth pressure. All gears are made of chrome nickel steel, accurately machined and heat treated, and are carried on chrome nickel steel shafts, heat treated and ground. Gears and shafts are mounted on pre-loaded tapered roller bearings, splash lubricated. Friction clutch control is mounted outside of headstock with multiple V-belt drive from motor in base to main pulley. Only three shafts and ten gears are used in the gear train of the ACME XL single threading machine, also available in double, triple and quadruple head models, in 1", 1½" and 2" sizes. *ACME XL Threading Machines with the new* Micrometer Adjustment *and the ACME Tangent Die Head* (patented) *will make production records in your shop. Ask for particulars.*

THE ACME MACHINERY COMPANY

Established 1882

4535 ST. CLAIR AVENUE

FORGING · THREADING · TAPPING

BOLT · NUT · RIVET MACHINES

Cleveland, Ohio

WASTE
IS QUICKLY
APPARENT
HERE . .
INDUSTRIAL
TYCOL
OILS-GREASES
TIDE WATER
THERE IS A COMPLETE LINE OF TYCOL LUBRICANTS

BUT WASTE FROM MACHINING PARTS went unnoticed here until discovered by TYCOL #655 CUTTING OIL

"The use of white lead and all special thread cutting oils has been eliminated since we switched to TYCOL #655 Cutting Oil – and more important, the quality of all threads has been improved. Cutting speeds are 25% faster.

"Even non-ferrous metals are entirely free from corrosion now. Tarnishing of machined parts is banished 100%. This oil will not oxidize on the metal bed or surface of slide-ways or spindle ways. In fact, it's a fine surface lubricant.

"Where it was formerly necessary to use several different oils to avoid difficulties, we now use TYCOL #655 Cutting Oil in all machines, on all metals and on all classes of work. We have solved all our machining problems with TYCOL #655 Cutting Oil."

Actual savings such as these have caused numerous manufacturers to use Tide Water Cutting Oils. You too may be able to increase production and quality by banishing waste. A Tide Water engineer will gladly assist you and offer practical recommendations to assure better results from your machines.

TIDE WATER ASSOCIATED OIL COMPANY

TIDE WATER DIVISION, 17 BATTERY PLACE

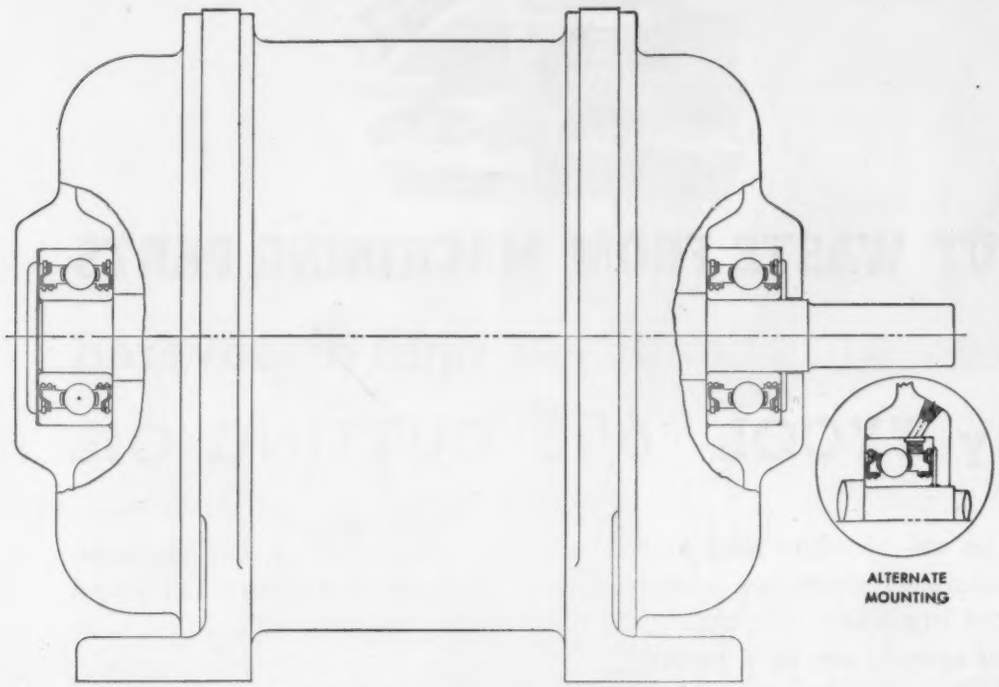
New York, N. Y.

TRANSPARENT
NON-TARNISHING
SULPHURIZED

CUTTING OILS

SCIENTIFICALLY ENGINEERED FOR EVERY INDUSTRIAL USE

MODERNIZE THE BEARINGS IN



THE IMPROVED

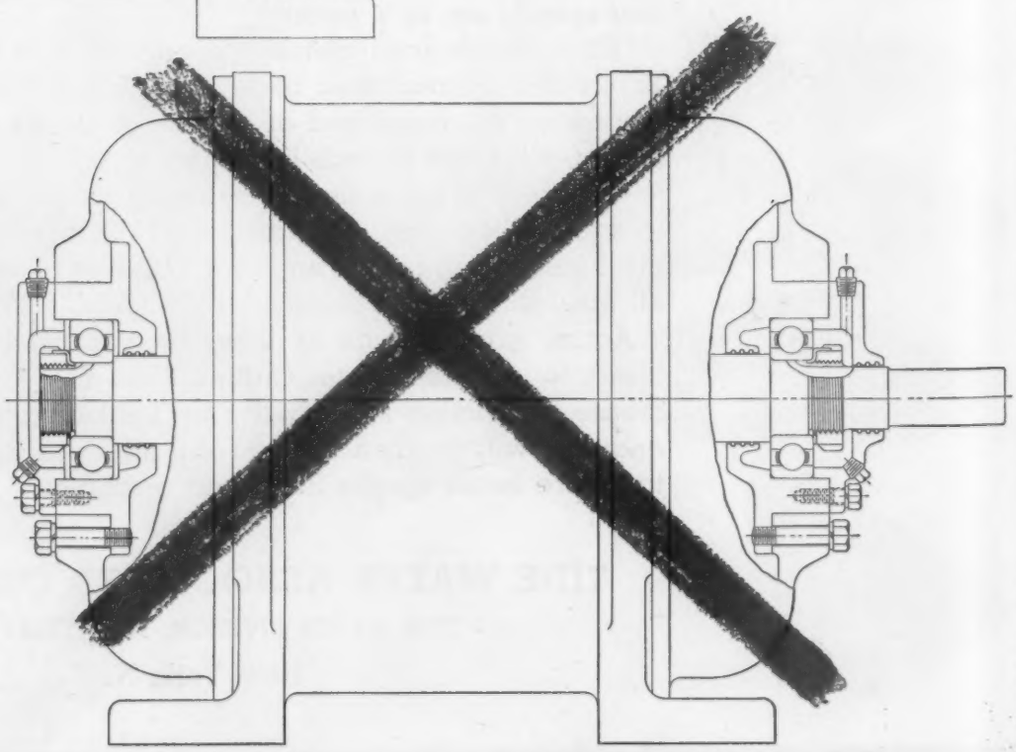
A Part Section of an Improved Motor Mounting with Ultra-Modern "CARTRIDGE" BALL BEARINGS.

THE PRESENT

A Part Section of a Typical Present-Day Motor with Unshielded Ball Bearings in the Conventional Cartridge Type Mounting.

•

See opposite page for machining operations and parts eliminated from this motor.



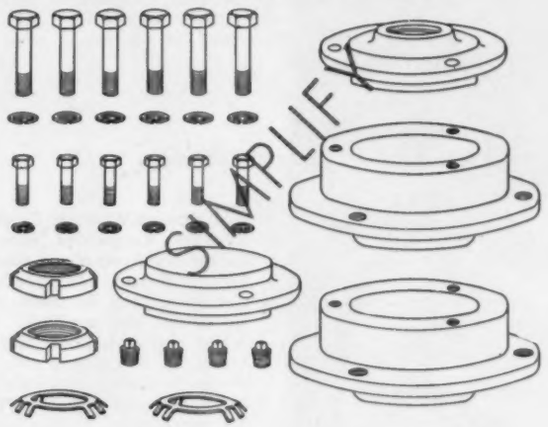
NORMA-HOFFMANN BEARINGS CORPORATION, STAMFORD, CONN., U. S. A.

USE "CARTRIDGE" BALL

YOUR MOTORS!

36 (OR MORE) PARTS ELIMINATED

Below are shown the extra parts required in the conventional cartridge type mounting. THESE ARE ALL ELIMINATED BY USING THE "CARTRIDGE" BALL BEARING,—18 parts per housing and 36 parts per motor.



30 (OR MORE) MACHINING OPERATIONS SAVED

Mounting the "CARTRIDGE" BALL BEARING in the motor housing requires only (1) Boring motor end housing for bearing, (2) Facing housing bore for bearing abutment—4 machining operations per motor.

The conventional cartridge mounting employing the unshielded ball bearing requires 30 additional machining operations per motor.

MACHINING OPERATIONS ELIMINATED

SAVE

1. Drilling Motor Housing for cap screws.
2. Machining Outer Diameter of Cartridge.
3. Facing Cartridge Flange.
4. Boring Cartridge for Bearing.
5. Facing Cartridge for Cover Plate.
6. Facing Cartridge Bore for Bearing Abutment.
7. Boring Cartridge for Shaft Clearance.
8. Drilling and Tapping Cartridge for Cap Screws.
9. Machining Flange of Cover Plate.
10. Facing Cover Plate.
11. Boring Cover Plate for Shaft Clearance.
12. Drilling Cap Screw Holes.
13. Drilling and Tapping for Grease Fittings and Drain Plugs.
14. Threading Shaft for Lock Nut.
15. Cutting Keyway on Shaft for Lock Washer.

Developed expressly to improve electric motor design and performance, the "ultra-modern" "CARTRIDGE" BALL BEARING offers the following advantages:

SIMPLIFIED DESIGN: As indicated above, eliminates 36 or more parts,—each an inventory burden and potential trouble-maker. Shortens overall length of mounting and reduces overhang of shaft.

ECONOMICAL MOUNTING: Cuts out the many costly machining operations enumerated above. Assures better bearing alignment because of fewer possible variables.

EASIER AND FASTER ASSEMBLY AND DISASSEMBLY: The "CARTRIDGE" BALL BEARING is handled as an integrally sealed, single unit unencumbered by numerous complementary parts.

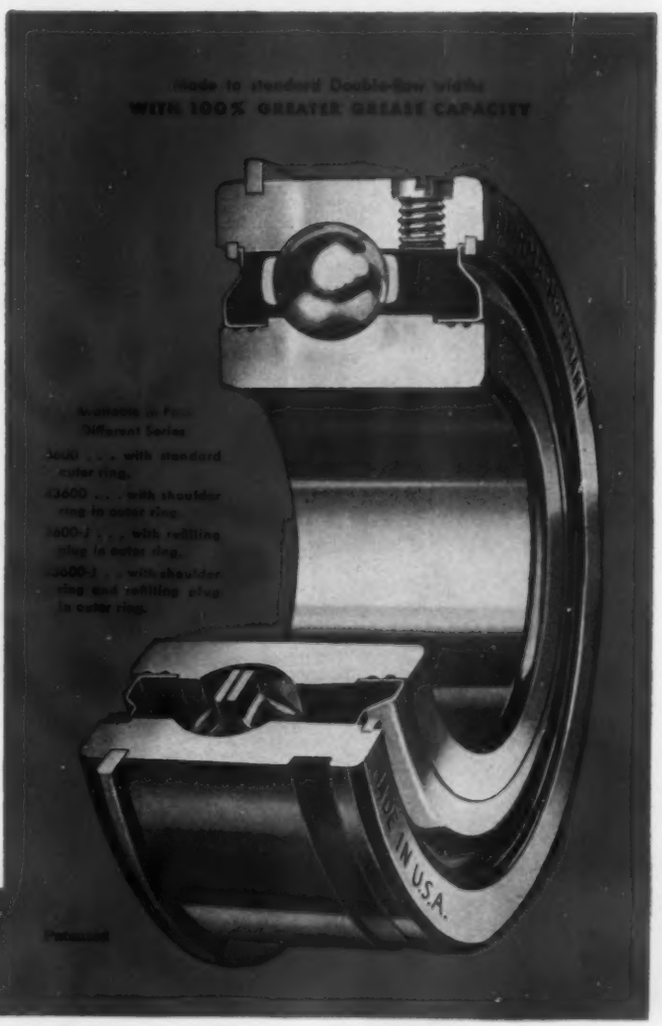
DIRT HAZARD ELIMINATED: Tightly-fitted seals prevent ingress of foreign matter during assembly, in service and when removing armature. The "CARTRIDGE" BALL BEARING comes pre-packed with clean, "stability-tested," uncontaminated grease.

SLIPPAGE, PEENING AND COCKING PREVENTED due to wider race contact area on shaft and in housing. No locking means required and elimination of threading permits use of stronger shafts.

LONGER LIFE AND LOWER MAINTENANCE, resulting from large, lasting grease supply kept in close proximity to rotating surfaces by highly efficient, wearless metal seals. No "dead" grease space and no leakage irrespective of position of motor.

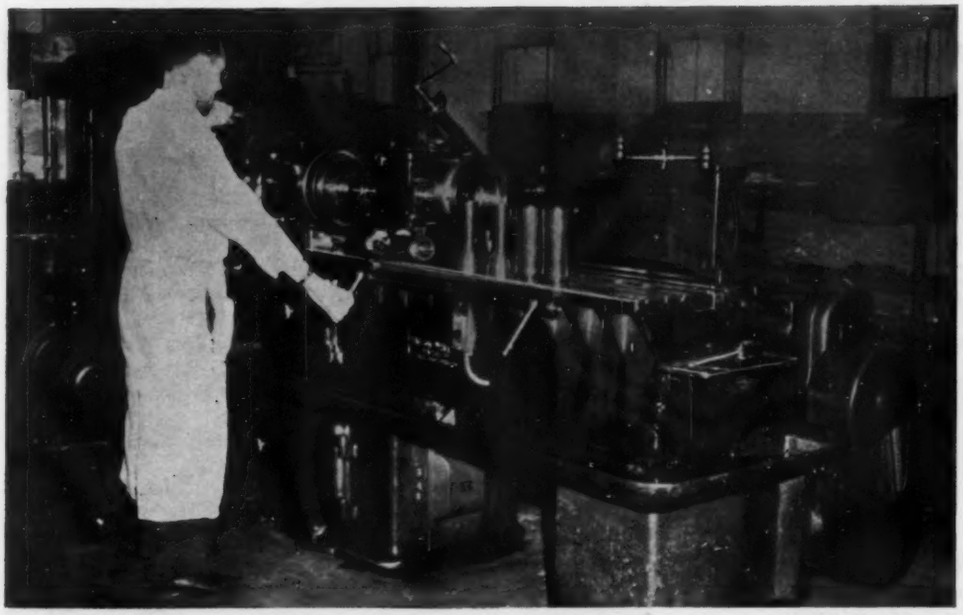
REGREASING AND INSPECTION FACILITATED, refilling plug and removable seals being provided for such purposes.

Let our engineers work with yours. Write for the Catalog.



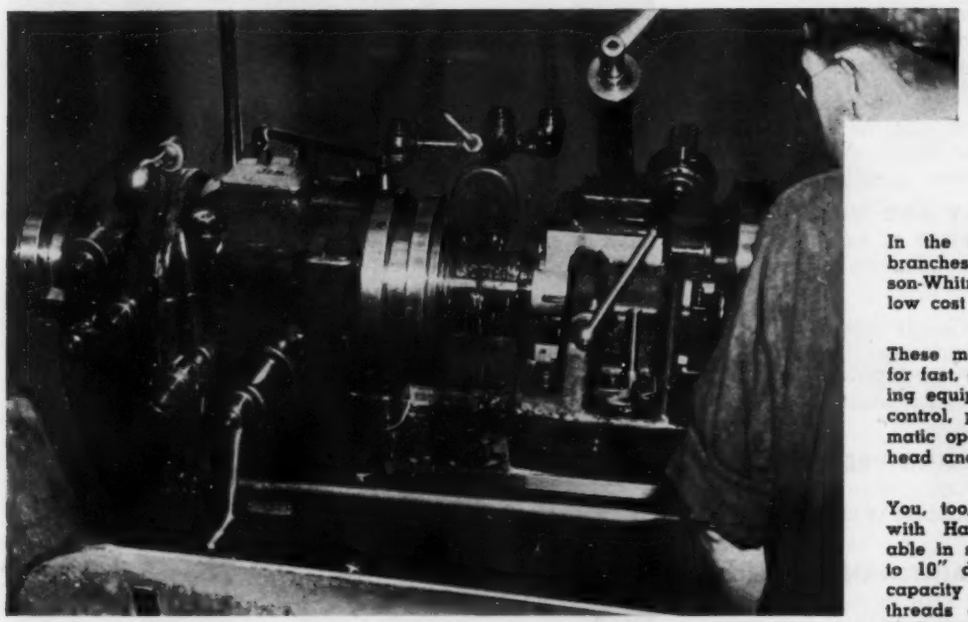
BEARINGS

Modern thread milling in the modern armory



This Hanson-Whitney Thread Miller —in the Automatics Shop of the Springfield Arsenal—is used in production thread milling of machine gun parts such as those shown on the bed of the machine. Work includes cutting internal and external threads. Stainless steel parts, where threads are likely to tear, are being successfully threaded on this machine.

•



Another H-W Thread Miller used in Springfield Armory thread production—Threads ¾" diameter are milled on 4" long stock; material is corrosive resisting Grade 3-A. The thread is completed in one revolution of the work.

•

In the armory as well as throughout all branches of the metal working industry, Hanson-Whitney Thread Millers insure high quality, low cost thread production.

These modern machines can be depended on for fast, accurate work regardless of the exacting equipments of the job. They are easy to control, powerful and equipped for semi-automatic operation. Individual motors drive work head and cutter head.

You, too, can modernize your thread milling with Hanson-Whitney Thread Millers, available in sizes to handle external threading up to 10" diameter and with internal threading capacity from ¾" to 10". Right or left hand threads can be milled on these time-saving, profit-earning machines. Write for detailed specifications.

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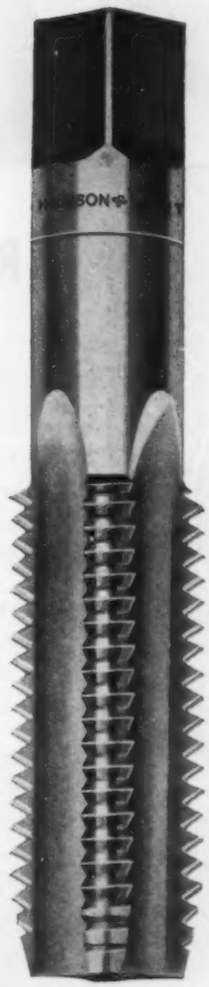
Accurately tapped holes assured with "HANSON-PROCESS" TAPS

Any production tapping job will prove the keen, accurate cutting of "HANSON-PROCESS" TAPS—the tougher the work, the more apparent the improvement in results.

Examine a "HANSON-PROCESS" TAP closely. Keen cutting edges — sharp and clean are immediately apparent. Inspect for lead, angle and diameter and its accuracy will parallel that in perfection of finish. Put it to work and check up on the number and quality of tapped holes produced—Measure this performance against that of ordinary taps and you'll find that "HANSON-PROCESS" Taps give you more and better tapped holes between grindings at less cost per tapped hole.

There's a reason for the superior and more economical performance of these modern taps. Finishing is done after hardening by the "HANSON-PROCESS" —a manufacturing feature which insures complete control of every detail that determines long life, keenness and maintained precision.



H-W Taps and other Precision Tools are fully described in the H-W Catalog. As a user of Taps, Gages, Hobs, Multiple Thread Milling Cutters, Precision Screws and Worms, you'll find many opportunities for savings in the H.W Precision Tool Catalog. Send for a copy.

THE HANSON-WHITNEY MACHINE CO. HARTFORD, CONNECTICUT

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CHECKS LEAD IN HALF THE TIME

COSTS LESS

TRADE MARK

Red Ring Helical Gear Lead Comparator

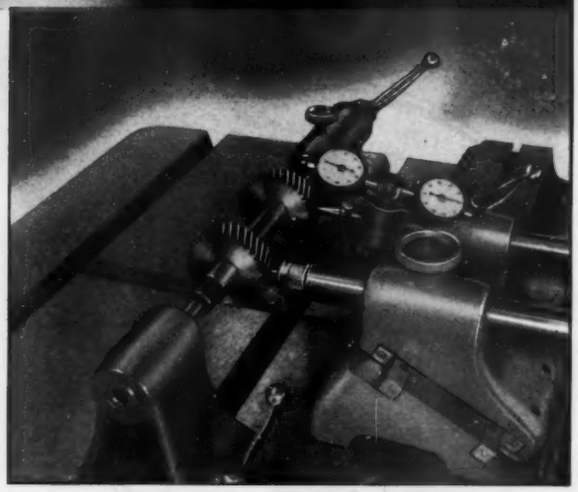
The Red Ring Universal Gear Tester, arranged for lead checking, costs you much less than any other comparable instrument. It will check lead of helical gears in about half the time required by other machines.

A simple device—easy to set up and use. No special skill is required. Almost any worker may be trained in a very short time to produce dependable results.

As the illustrations show, a master gear, or master disc, of correct lead is used. A guiding pointer fixed to the comparator head contacts the master. A recording pointer, connected by a bell crank to a dial indicator contacts the work gear. The comparator head is moved horizontally by a hand wheel, the fixed pointer rotates the master gear or disc and the work gear in unison. As the recording pointer traces across the work gear tooth, lead errors show on the indicator dial.

Gears integral with shaft as well as arbor mounted gears can be checked.

Internal gears may also be checked for lead by using a special pointer in the holder.



Lead checking from a master gear—work gear mounted on arbor.

Lead checking from a master disc—work gear integral with shaft.

WRITE FOR DETAILS

NATIONAL BROACH & MACHINE CO.

SHOEMAKER AND ST. JEAN

DETROIT, MICHIGAN, U.S.A.

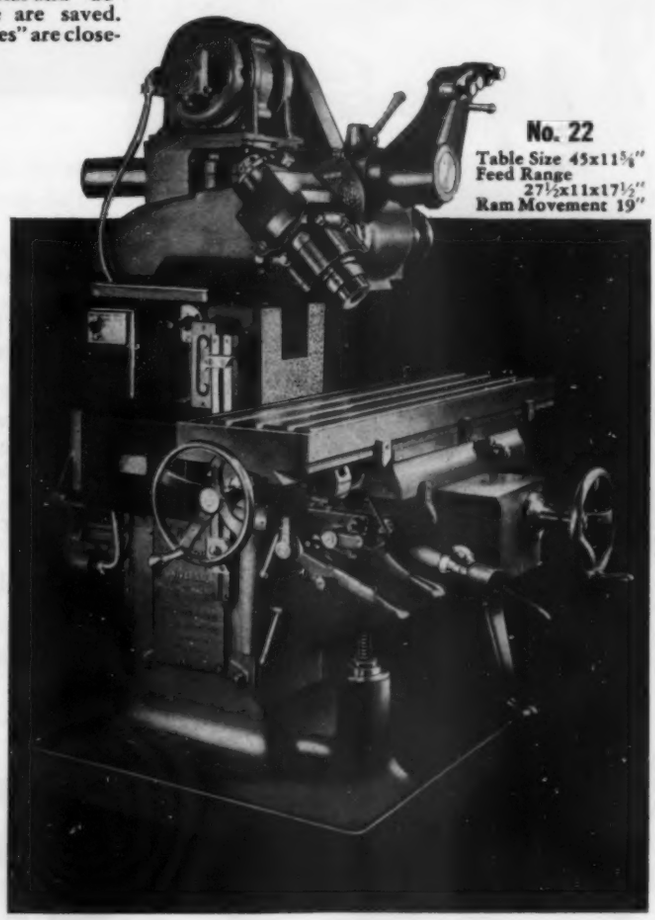
SAVE TIME: Up to ½ the usual set-up time or ⅓ total job time. Positionable range of cutterhead, combined with ram-movement, simplifies set-up and permits various cuts without reset-up.

STEP UP OUTPUT: Savings in time and safeguarding of accuracy . . . together with the adaptability of Van Norman Universals to more kinds of milling . . . mean capacity for larger work-schedules.

AVOID ERRORS: Fewer reset-ups mean fewer errors . . . less chance of spoiled work and rejects. Material and "do-over" time are saved. "Finish-dates" are closely held to.

SAVE MONEY: Adaptability to many types of work . . . speed, power and rigidity for conventional work . . . give you the capacity of several machines in one.

IMPROVE QUALITY: Avoidance of errors directly results in a consistently higher standard of quality . . . a special benefit on extremely difficult, costly work like dies, jigs, etc.



No. 22
Table Size 45x11¾"
Feed Range
27½x11x17½"
Ram Movement 19"

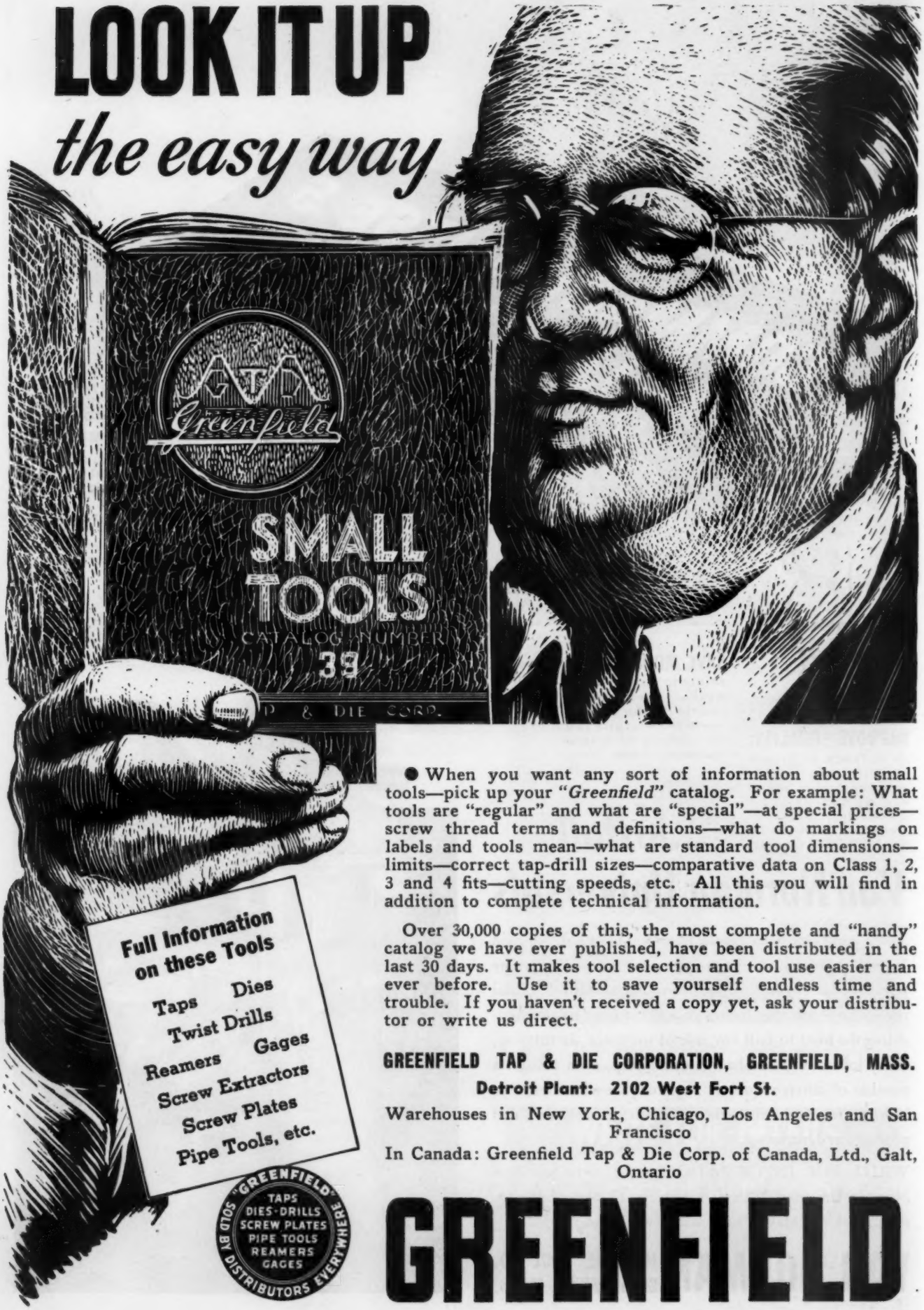
. . . install
Van Norman Universals

These profits are based on the adaptability of Van Norman Universal Millers . . . the swiveling cutterhead that can be positioned at any angle from horizontal to vertical . . . and the sliding ram that moves in and out over column, enabling the head to mill any side of the piece. In this way, many jobs can be finished in one set-up, even though a number of different cuts are required. See what these Van Norman features will mean in *your* shop, laboratory and production department.

WRITE FOR INFORMATION on all of the four Van Norman Universal Millers. Complete TR Series bulletins for the asking. Make a note *now* to write *today.*

VAN NORMAN MACHINE TOOL CO.
SPRINGFIELD, MASS.

LOOK IT UP
the easy way



● When you want any sort of information about small tools—pick up your *"Greenfield"* catalog. For example: What tools are "regular" and what are "special"—at special prices—screw thread terms and definitions—what do markings on labels and tools mean—what are standard tool dimensions—limits—correct tap-drill sizes—comparative data on Class 1, 2, 3 and 4 fits—cutting speeds, etc. All this you will find in addition to complete technical information.

Over 30,000 copies of this, the most complete and "handy" catalog we have ever published, have been distributed in the last 30 days. It makes tool selection and tool use easier than ever before. Use it to save yourself endless time and trouble. If you haven't received a copy yet, ask your distributor or write us direct.

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Now IGNITRON CONTACTORS

for Silent Spot-welding Control

G-E ignitron contactors operate as fast as 350 times a minute, and yet normally require inspection less than once every six months

GENERAL ELECTRIC ignitron contactors control spot- and projection-welding circuits without the use of moving parts and without making a sound. The making and breaking of the welding circuit takes place within sealed ignitron tubes. There is no hammering when the contactor closes; no arcing when it opens. There are no contacts to adjust, there is no need for frequent inspection.

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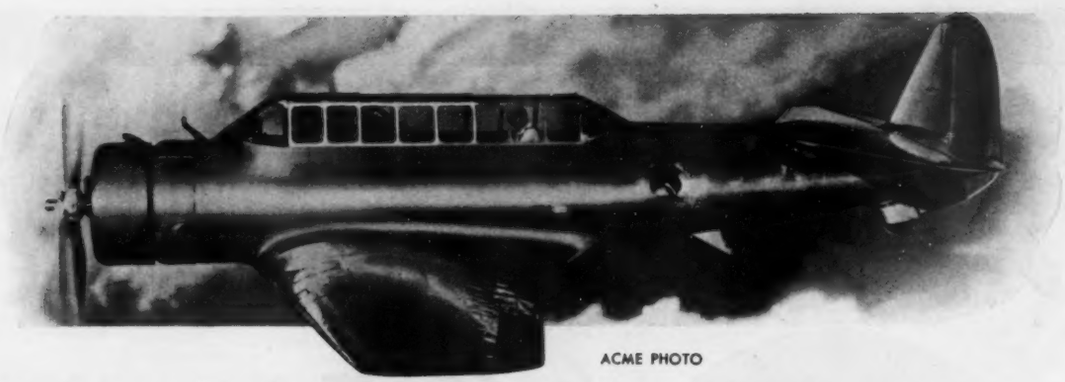

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. . . Making Them Needs the Precision of

STARRETT TOOLS

Starrett Tools, Dial Indicators and Hacksaws are essential for exacting work in any branch of the metal working industries. Write for Starrett Catalog No. 26C.

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World's Greatest Toolmakers — Manufacturers of Hacksaws Unexcelled
Steel Tapes, Standard for Accuracy — Dial Indicators for Every Requirement

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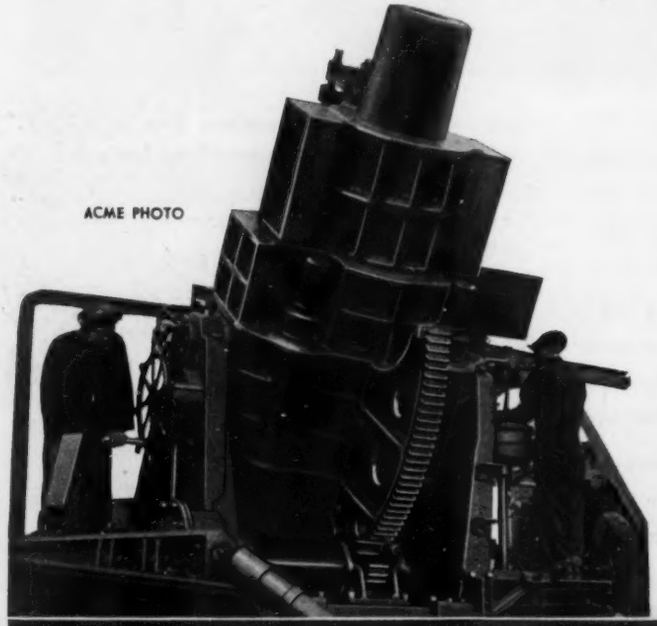

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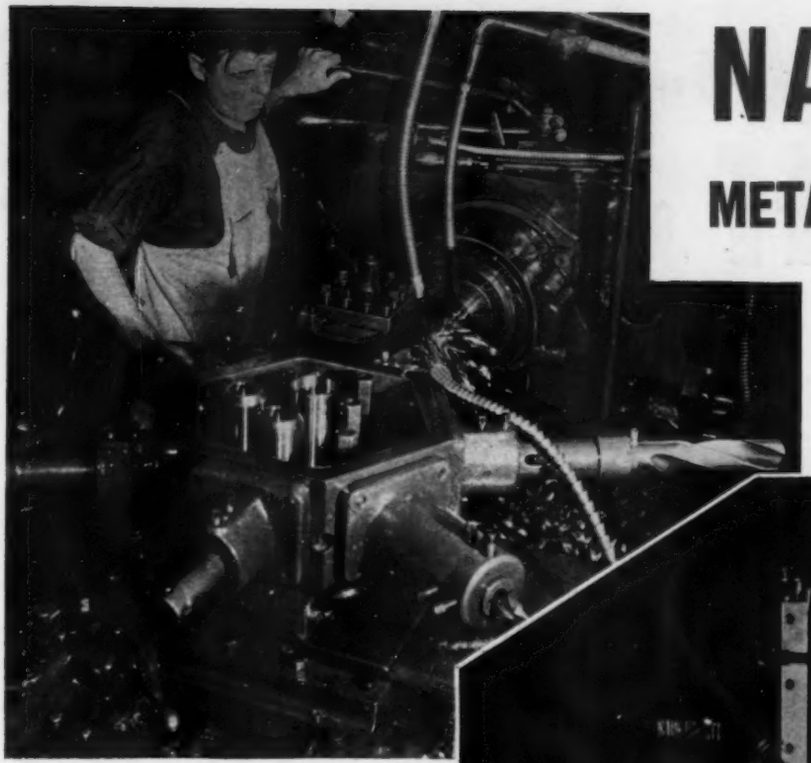
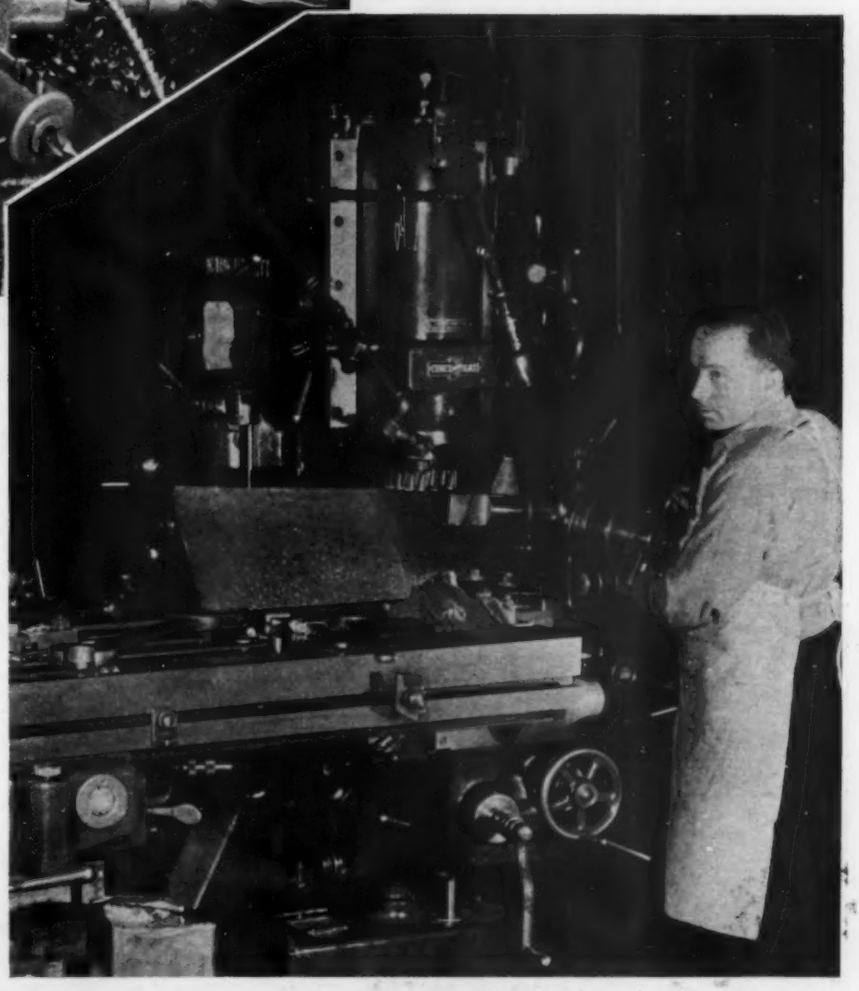


NATIONAL

METAL CUTTING TOOLS AT WORK



IN THE SPRINGFIELD ARMORY

a 2" National Twist Drill ready for action on a Warner and Swasey Lathe used for drilling stainless steel at high speeds.

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IN THE BROOKLYN NAVY YARD

a National Adjusto-Lock Inserted Blade milling cutter on a Cincinnati Miller machining a swivel.

NATIONAL

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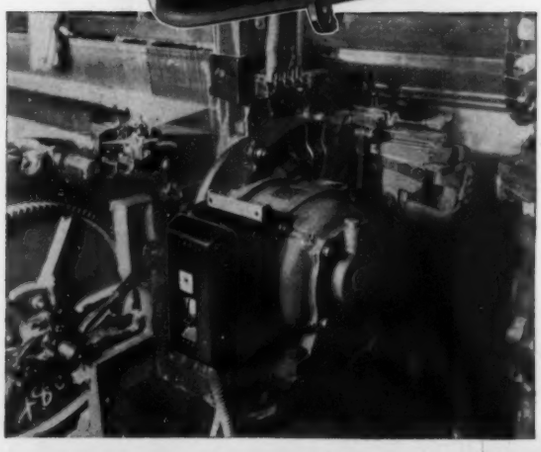
IT'S EASY TO SEE WHETHER THIS STARTER IS on-off OR tripped



New "De-ion" Starter for Motors up to 7½ hp

This new manual starter, the Westinghouse Motor Watchman, has an indicating handle on the front of the starter. It shows the operator or inspector at a glance whether the starter is tripped, on, or off. Smaller, more compact, it is easily mounted on or near the machine. Saves time . . . saves guessing . . . saves space.

You get all these advantages only in the new Motor Watchman

- Westinghouse "De-ion" Arc Quenchers protect contacts from flashovers . . . prolong contact life.
- Snap action bi-metal disc relay protects motor from overload. Resets to correct calibration — nothing to replace.
- Safety interlock prevents accidental contact with live parts.

For complete data, ask your nearest Westinghouse office, electrical wholesaler or industrial agent.

WESTINGHOUSE ELECTRIC & MANUFACTURING CO.
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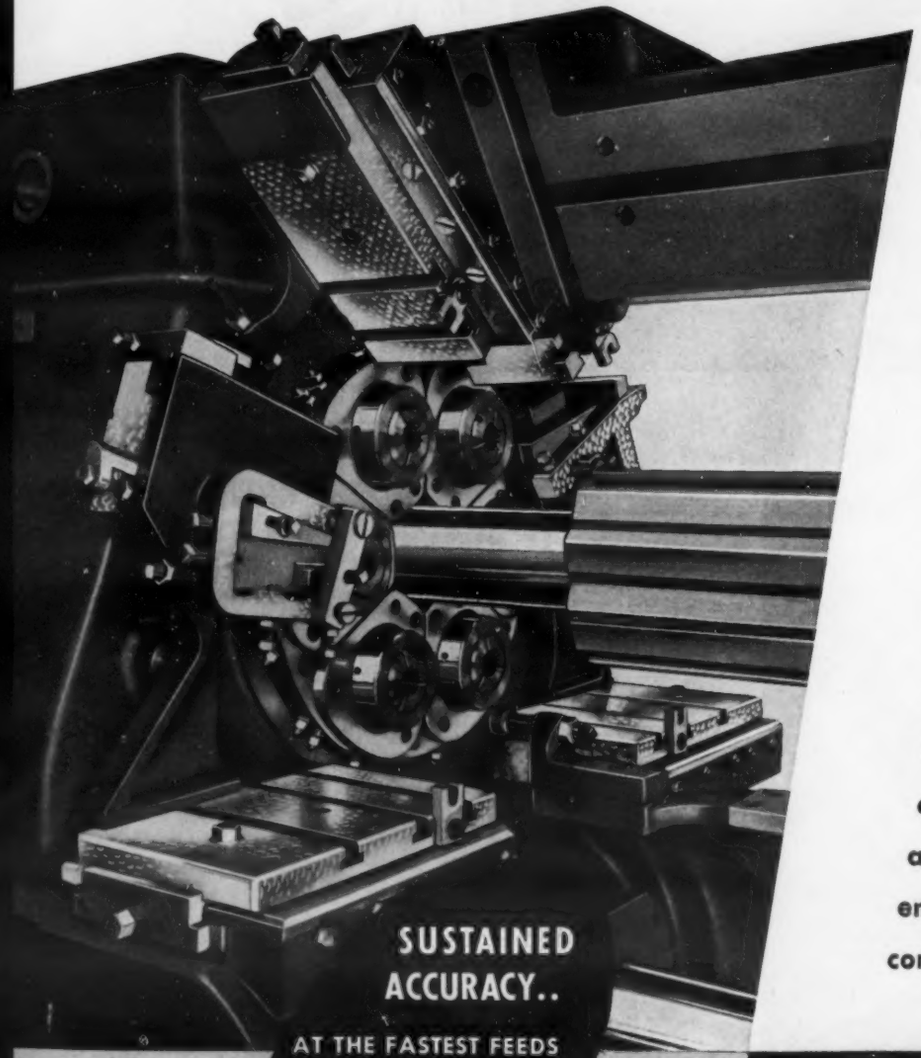
Westinghouse Motor Watchman

W WESTINGHOUSE ELECTRIC

..Models RA-6 and 8 Spindle *Acme-Gridleys*

give you 6 SIDE SLIDES

-independently operated!



The 9/16" Model RA

Finer—faster, and at still lower cost—that's the day-to-day record on hundreds of bar jobs being produced right now on 6 and 8 spindle automatics... With the new Acme-Gridley independent slide control all cam and roll contacts to slides are reduced to the shortest possible linkage... This powerful, direct tool action with freedom from chatter permits coarser feeds up to the safe limits that tools will stand... without penalizing the feeds for finishing cuts... Acme-Gridley independent slide control also increases the accessibility to tools for set-up and adjustment... and the use of all 6 slides provides a wider selection of standard and special tools essential to speed and finish on intricate work... Ask our engineers to give you guaranteed production figures based on independent slide control, for finer, faster, lower production costs on your bar and chucking work.

Send samples or prints to the factory at Cleveland, Ohio

NATIONAL ACME

ACME-GRIDLEY 4-6 AND 8 SPINDLE BAR AND CHUCKING AUTOMATICS • SINGLE SPINDLE AUTOMATICS • SELF OPENING DIES AND COLLAPSING TAPS • THE CHRONOLOG • POSITIVE CENTRIFUGE • SCREW MACHINE PRODUCTS • CONTRACT MANUFACTURING

LOOK THROUGH THE BORE

Rough cast "sticks" are more expensive. Bunting Precision Bearing Bronze Bars save you *waste* of metal, *waste* of labor, and *waste* of time.

Also available from stock are hundreds of different sizes of Bunting Standardized Bronze Bearings, and Electric Motor Bearings for all makes of motors from 1/50 to 100 hp.

● Bunting Precision Bearing Bronze Bars are not just machined I.D., O.D. and ends, but under that smooth surface is *S. A. E. 660 bearing bronze*—the universal bearing alloy originated by Bunting for longer bearing life and better performance—perfected by our improved casting process to guarantee a uniform structure free from defects. Hundreds of sizes—solid and cylindrical—are stocked by leading mill supply wholesalers. Write for complete catalog and technical data. . . . The Bunting Brass & Bronze Company, Toledo, Ohio. Warehouses in All Principal Cities.

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BRONZE BUSHINGS • BEARINGS
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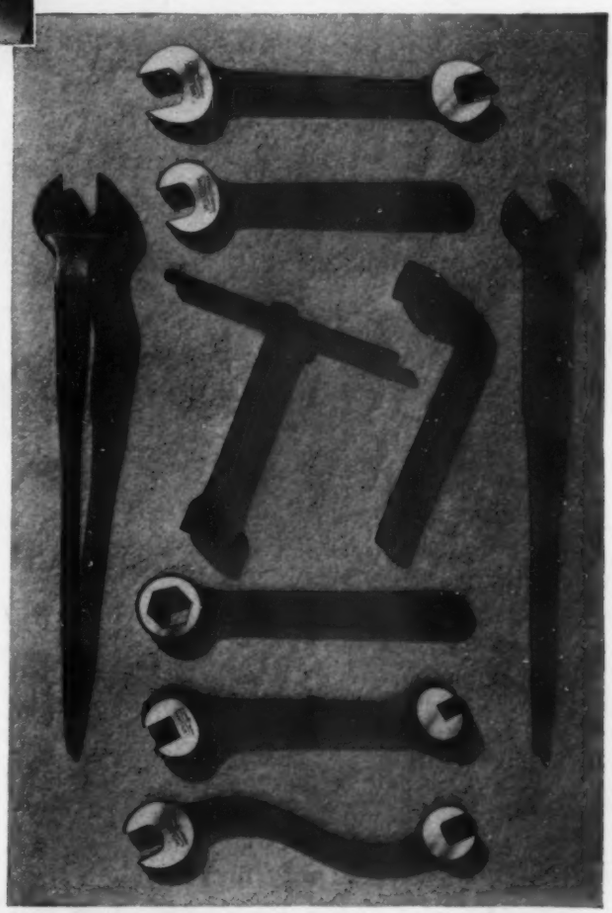
WILLIAMS "SUPERIOR" (IMPROVED CARBON STEEL) WRENCHES

MADE IN 50 DIFFERENT TYPES



● **Regardless of what type of wrench you need, you'll probably find the exact pattern and size required in a Williams' "Superior" Wrench—50 different types . . . over 1000 standard sizes.**

"Superior" Wrenches are drop-forged from a specially-processed Carbon Steel. They are approximately twice as strong as old-fashioned carbon steel wrenches, yet cost no more. *They closely approach the strength of the finest alloy steel wrenches, which sell for about double their price!*

Get the facts. Ask your industrial distributor, or write for our free booklet "How to Select and Use Wrenches."

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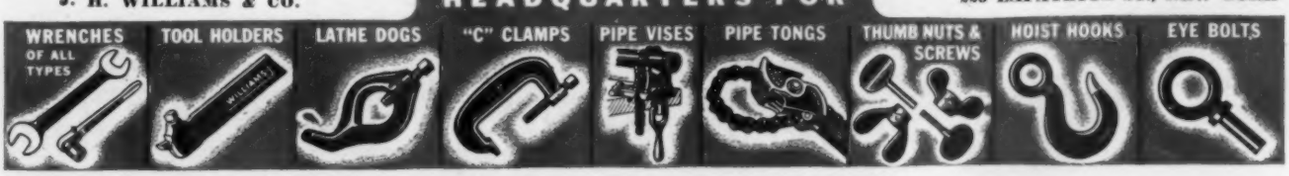

Springfield Arsenal

IMPROVES MACHINABILITY OF HEAT TREATED PARTS AND EXTENDS TOOL LIFE . . .

27" x 36" American WHEELABRATOR TUM-BLAST at Springfield Arsenal. There were about 1500 small rifle parts in the machine being cleaned at the time this photograph was taken.

. . . by WHEELABRATING

the modern low-cost method of cleaning

BY thoroughly cleaning small rifle parts of all kinds after heat treating in an American Wheelabrator Tum-Blast the Springfield Arsenal insures freedom from hard abrasive scale and avoids high costs in machining and finishing operations.

Not only does the Wheelabrator Tum-Blast speed up metal cleaning but it also cuts cleaning costs. Products cleaned are brighter, better finished and can be machined more readily with less tool wear.

The American Wheelabrator Tum-Blast—the original airless abrasive blasting machine—is extensively used for cleaning cast, forged and stamped products. It is made in several sizes for cleaning large or small quantities of work in which pieces may vary from fractions of an ounce up to 300 pounds. The Wheelabrator is also available in table types and in special designs.

Find out more about the Wheelabrator Method — the savings it is making in leading plants—the cost-cutting possibilities it offers you on your work.

American FOUNDRY EQUIPMENT CO.

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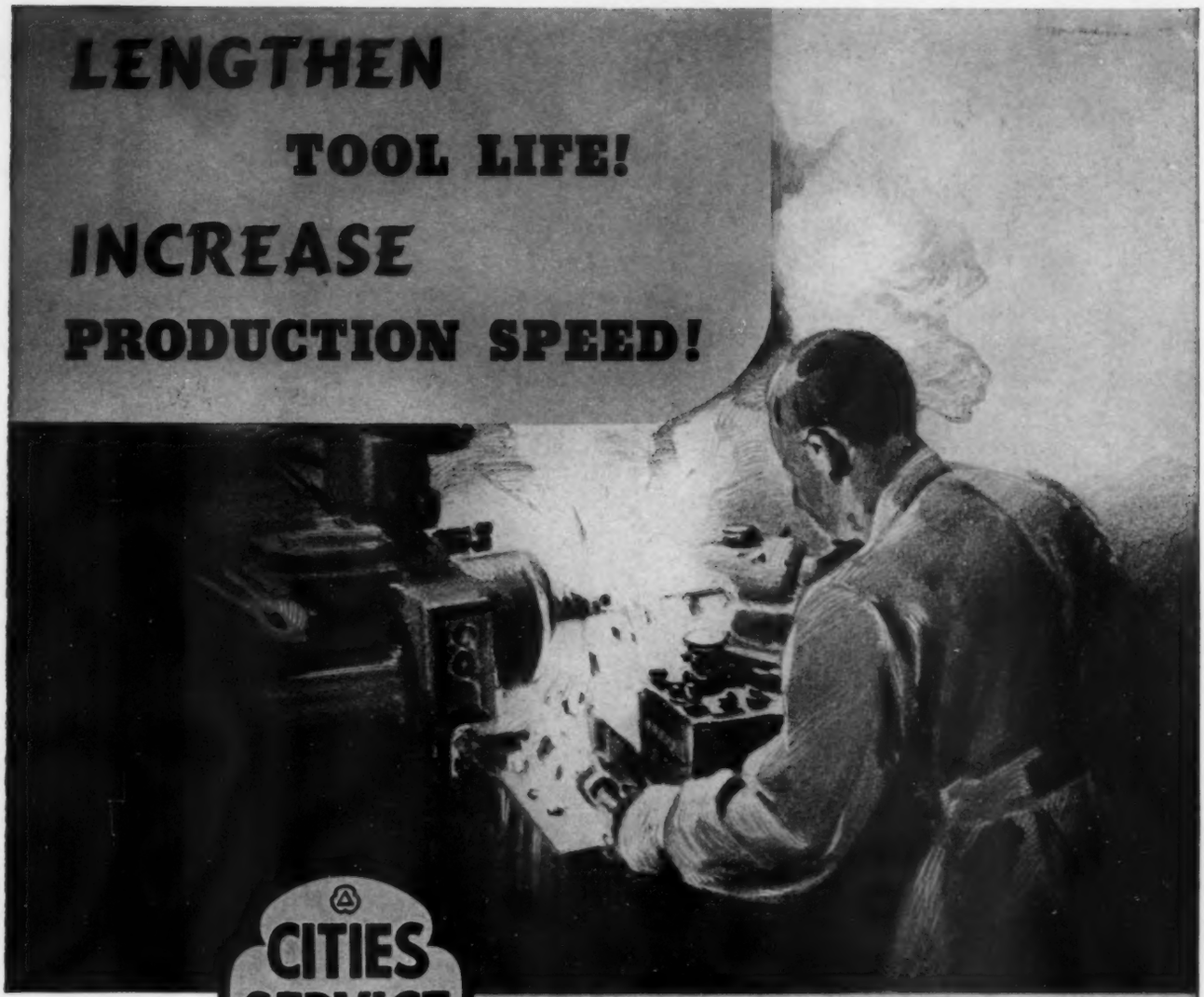
SAVE by using AIRLESS WHEELABRATOR CLEANING

LENGTHEN TOOL LIFE! INCREASE PRODUCTION SPEED!



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● Increased production speed! . . . Longer tool life!—How often have these been your worries?

Cities Service Cutting Oils can help you to attain these ends because they are *Service Proved—proved in Service* by satisfying, discriminating and exacting customers—turning out not only good but superior work.

Built into the Cities Service Cutting Oils you buy, are:

Experience—arising out of many years of service to the metal working industry—

Uniformity—the result of careful laboratory control—

Low Cost—resulting from complete integration of production, refining and marketing—from oil well, to pipe line, to refinery, to your shop.

Have you a metal cutting lubrication problem? If so, our Lubrication Engineers' Consulting Service will help you solve it. There is no obligation. This service is free. Also, if you'd like a copy of our new booklet, "Metal Cutting Lubrication—In Theory and Practice," it's yours for the asking.

This is the "Heat Prover"—an ingenious device that might be helpful to you. It's a by-product of our research in metallurgy. It registers, continuously and instantaneously, changes in the amount of oxygen and combustibles in furnace gases. Invaluable in the heat treatment of metals—assures uniformity and reduces scrap losses.

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Please send me information concerning your Engineers' Lubrication Service.....(check box) ☐
Please let me know how I can get Heat Prover Service.....(check box) ☐
Please send me folder on Cutting Oils....(check box) ☐

Name _____

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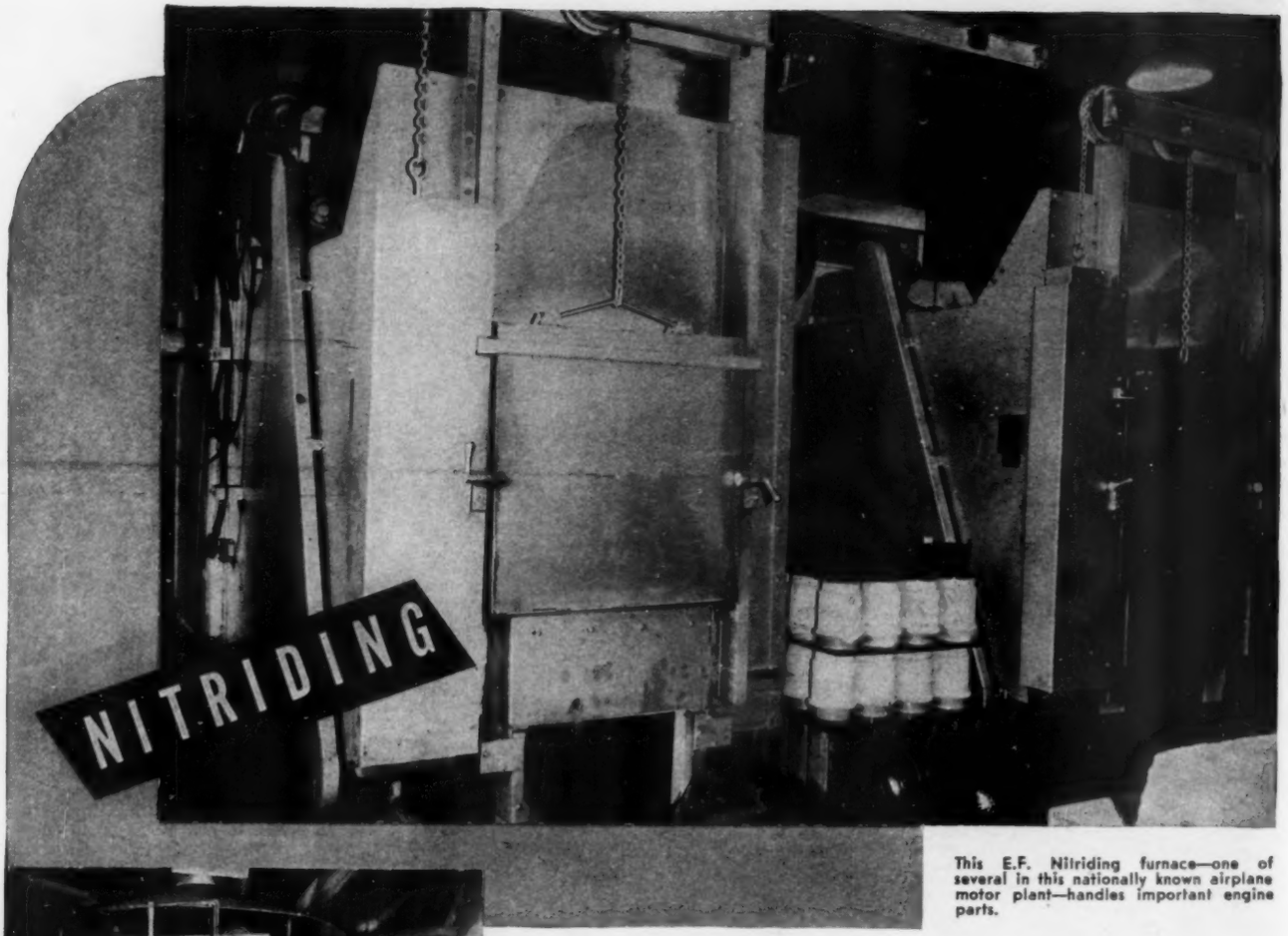
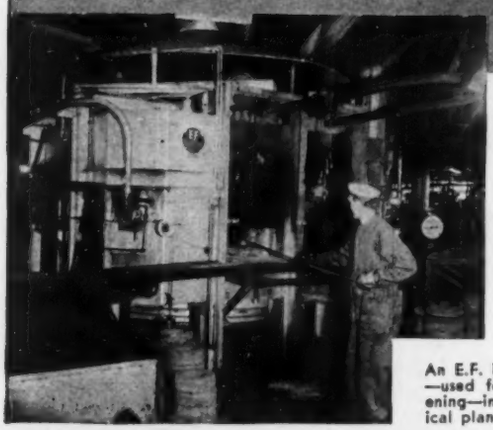
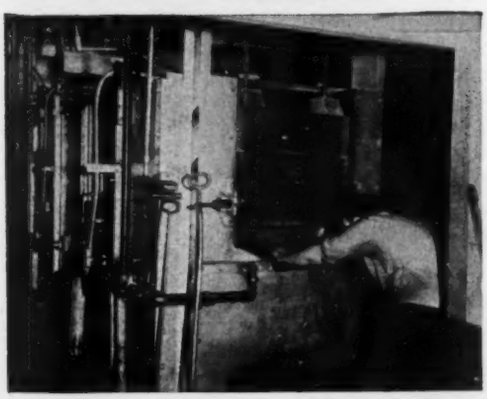
SERVICE PROVED INDUSTRIAL OILS



This E.F. Nitriding furnace—one of several in this nationally known airplane motor plant—handles important engine parts.



An E.F. Fuel Fired Rotary Furnace —used for normalizing and hardening—in the Wright Aeronautical plant.



An E.F. Chain Belt Conveyor Furnace used for heat treating a wide variety of parts in the Wright engine plant.

Wright Aeronautical uses **E.F. FURNACES**

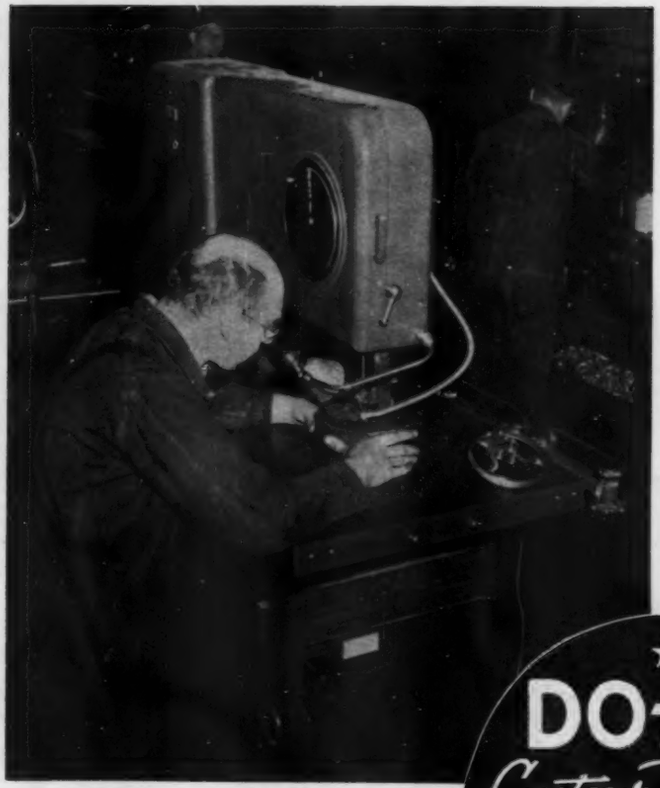
Nitriding, annealing, normalizing and hardening of aircraft engine parts are handled in the Wright Aeronautical Plant at Paterson, New Jersey in E.F. Furnaces.

These modern furnaces provide fast, accurate and economical methods for handling the work assigned them.

As specialists in designing and building all types of furnaces—electric as well as fuel fired—we invite you to submit your furnace and heat treating problems to E.F. engineers for careful attention and the correct solution.

The Electric Furnace Co., Salem, Ohio

Gas Fired, Oil Fired and Electric Furnaces---For Any Process, Product or Production



Offering battleship ruggedness for NAVY *needs . . .*

Fast, smooth, accurate work is the universal report from users of Do-All Machines.

This is the kind of work demanded of the Do-All in the shops of the Brooklyn Navy Yard. The machine shown here is sawing out a blank of stainless steel for a steam engine valve seat at a speed of 50 feet per minute.

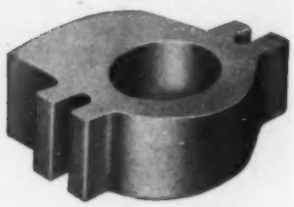
DO-ALL
Contour Machines
BAND SAWING
BAND FILING
BAND POLISHING

Insuring "on-the-line" precision in ARMY *production*

Do-All Machines also play their part in national defense in the tool room of the Springfield Arsenal, for cutting out internal and external shapes from any metal up to 10" thick.

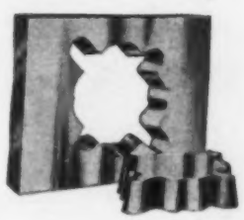
A TRIPLE THREAT TO HIGH COSTS

The Do-All handles band sawing, filing and polishing —three operations offered in one machine by a simple conversion. Jobs which ordinarily would take days are produced in hours on Do-Alls. Write for our 100-page Hand Book on Contour Machining—Free on request.



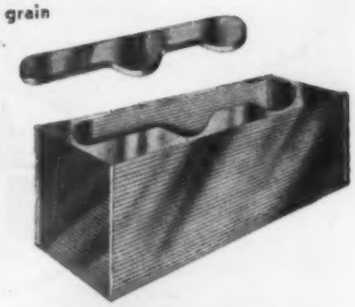
2 DAYS AND 3 HOURS SAVED

Shephard Machine Co. of Cleveland made this special die shoe from 4" oil hardened tool steel in 5 hours, on the Do-All. Formerly it required 3 full days' milling, shaping and boring. Material saved: 26-pound slug.



THE SLUG WAS USED FOR THE PUNCH

Anderson & Sons, Springfield, Mass. cut this 2" thick die at an angle on a Do-All, so clean that the slug was used for the punch. Two parts cut at one time from one piece of alloy steel. Result: time and steel saved; also, grain was the same in punch and die.



51 PARTS AT ONE TIME

Bethlehem Shipbuilding Corp., Quincy, Mass. arc welds corners of 51 separate plates to hold them firm. Then, on a Do-All 51 parts are cut out at one time with no rough or "burned" edges.

CONTINENTAL MACHINES, INC.

1310 S. WASHINGTON AVE.
MINNEAPOLIS, MINNESOTA

B & S SCREW MACHINE

Screw machine department in plant of International Business Machines Corporation, Endicott, N. Y. Supt. Hancock reports that the maximum production obtained here is due to 3 things — the selection of proper machine tool equipment, rigid specifications as to composition and uniformity of material, and THE CORRECT OIL. He uses Texaco Sultex Cutting Oil.

TEXACO
REG. T.M.

TEXACO

PERFORMANCE AT

BUSINESS INTERNATIONAL MACHINES

THESE PIVOT STUDS, 9/16" dia., high sulphur screw stock, machined on B & S No. 0 Screw Machines at the rate of 54 pieces an hour. Surface feet per minute, 286. Texaco Sultex Cutting Oil used.

THE I.B.M. PLANT at Endicott, N. Y., is a large user of Brown & Sharpe Automatic Screw Machines. For 5 years, I.B.M. has also been a large user of TEXACO SULTEX CUTTING OILS.

Supt. Hancock is convinced that Texaco Sultex Cutting Oils have played their full part in

STEPPING UP OUTPUT
INCREASING TOOL LIFE
PRODUCING BETTER FINISH

After 5 years' constant use of Texaco Sultex Cutting Oils, I.B.M.'s Brown & Sharpe Screw Machines today are outperforming previous records.

Experienced lubrication engineers will be glad to demonstrate what savings Texaco Perfected Lubrication can make for you.

For this engineering service and prompt deliveries, phone the nearest of our 2229 Texaco warehouses.

The Texas Company, 135 East 42nd Street, New York.

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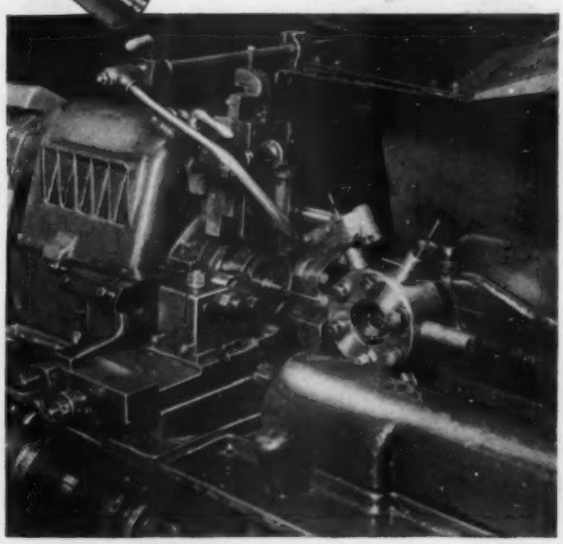
Texaco Dealers invite you to tune in The Texaco Star Theatre—a full hour of all-star entertainment—Every Wednesday Night—Columbia Network— 9 E.D.T., 8 E.S.T., 8 C.D.T., 7 C.S.T., 6 M.S.T., 5 P.S.T.

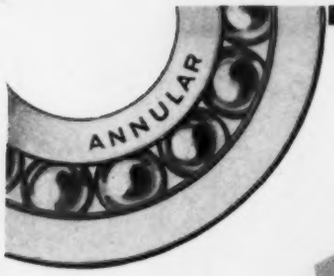


CLOSE-UP of pivot stud job in No. 0 B & S Screw Machine at Endicott, N. Y., plant of I.B.M. For 5 years, Texaco Sultex Cutting Oil has helped these B & S Automatics to improve output, tool life, finish.

SULTEX

Texaco Sultex Cutting Oil is an active type cutting oil. It has been used successfully in B & S Machines by International Business Machines Corp. for five years.

CUTTING AND SOLUBLE OILS



for ALL machines and PRODUCTS

"Commercial" Annular Ball Bearings are used in hundreds of different industries and products. High efficiency and low cost combine to make these bearings the choice of manufacturers who seek precision performance. **"Commercial"** Annular Ball Bearings are self-contained. Speeds up to 2500 R. P. M. Dual thrust capacity. Overloads and side-thrusts easily sustained. High grade steels, carefully heat-treated, assure strength and stamina essential to long service.

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IS DEPENDENT ON HIGH SPEED STEEL FOR THE MANUFACTURE OF ORDNANCE AND MUNITIONS

During the World War, the shortage of tungsten, the essential alloying element for high speed steel, was a major problem, and if it were not for MO-MAX, the same problem could arise again.

MO-MAX

TRADE MARK REG. U. S. PAT. OFF.

IS THE STRATEGIC HIGH SPEED STEEL

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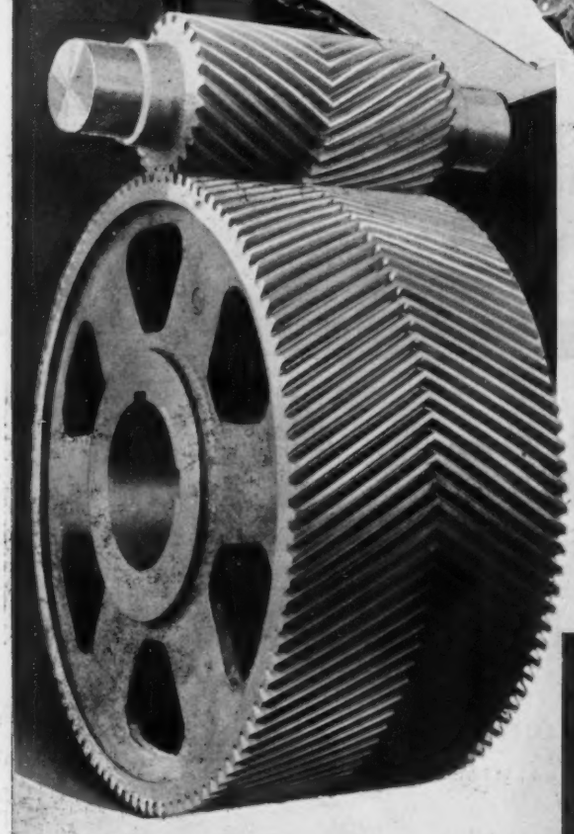
It is a proven quantity and has long since passed the experimental stage. Its use has increased in peace times until it is now the standard of quality for high speed tools.

For information, write

The Cleveland Twist Drill Co., Cleveland, O.



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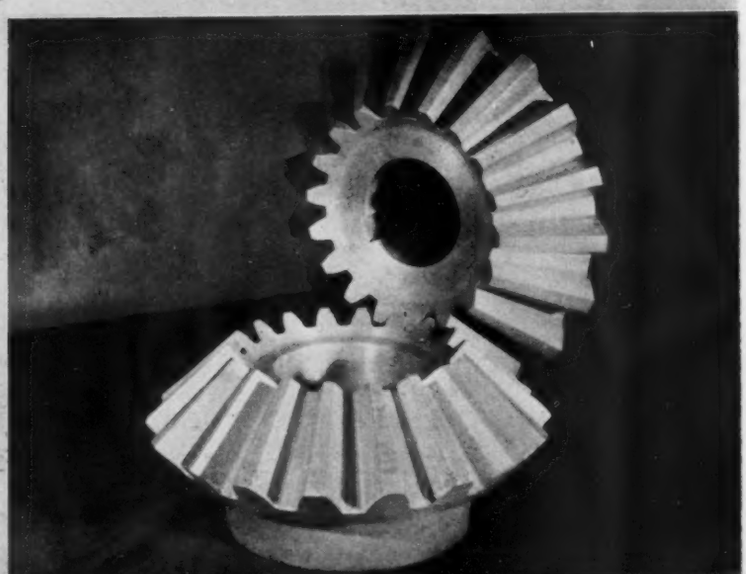
WITHIN one plant . . . under one management . . . with one responsibility, are produced steel castings . . . rough, finished, heat treated as specified . . . Diversified, industrial Neloy gears for highly specialized applications . . . Complete assemblies of gears and housings . . . That is the day's routine here at National-Erie Corporation . . . Complete facilities are available for your specific requirements . . . To prove it, simply ask for bulletin No. 5 on your regular letterhead . . . no obligation whatever . . . Your orders will be handled promptly and efficiently.



ABOVE, a Neloy 10-B Sykes Herringbone main drive gear and pinion with flame hardened teeth. Gear cast in Neloy electric steel, machined and flame hardened under National-Erie control. At the right, special Neloy 10-B roll table mitre gears. Full description of Neloy on page 15, bulletin No. 5. Write for it!

NATIONAL-ERIE CORPORATION

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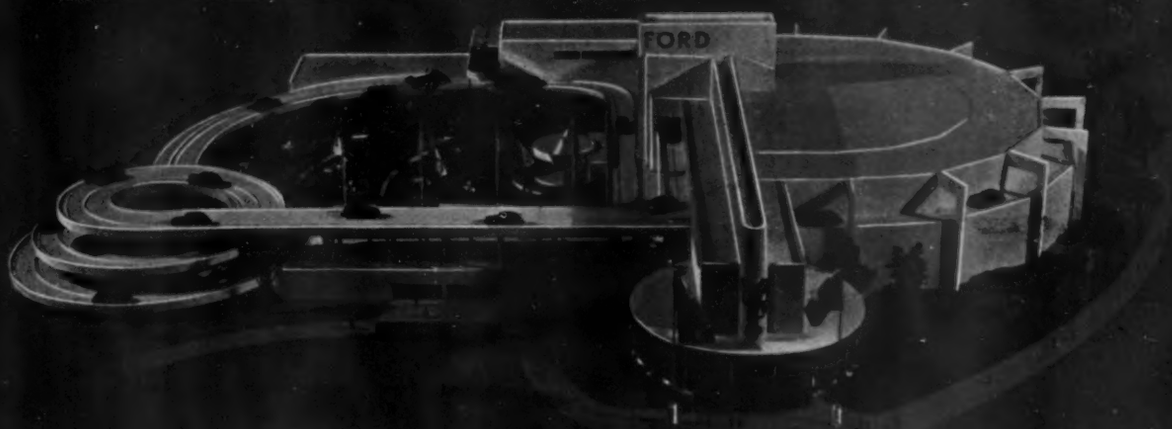
FEDERAL BEARINGS



SEE THE FEDERAL BOUNDING BALL
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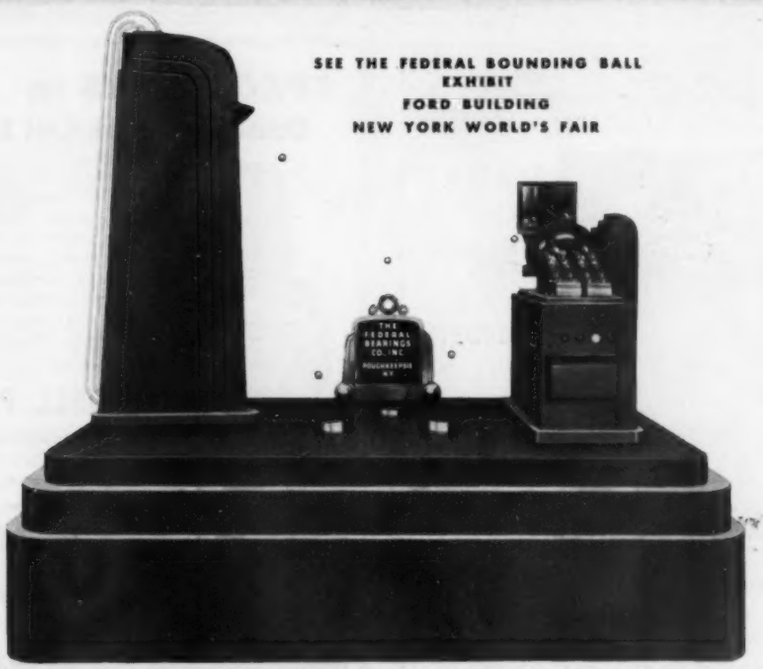

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Industrial Gears and Speed Reducers

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ALL TYPES

Herringbone, Spur, Worm, Internal, Bevel, Miter, Spiral, Spiral-Bevel, Intermittent, Helical and Non-Metallic

ALL SIZES for Industrial Use

ALL MATERIALS

. . . of the finest quality, suitably selected for the required service. Careful attention, promtly given to all orders.

Spiral Bevel Gear and Pinion

Gear Specialties

14 to 96 D. P.

SPURS

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14 to 96 D. P.

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GEARING

—such as these, and numerous others, are the logical product of a skilled organization with a deft 'feel' for *precise* work. . . . Note the *Combination* Worm-gear, rotating as a Gear on one side and as a Worm on the opposite side.

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SPECIALISTS in Quality Gears Cut to Order

MEISEL produces but one *kind* of gears . . . gears constructed for specific jobs. Only through the inherent accuracy of this special designing could such dependability, performance, and economy be possible. Tell us what you expect it to do, and we'll show you the *one* gear suited for your job.

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HARTFORD GEARS

THE HARTFORD SPECIAL MACHINERY CO. Hartford, Conn.

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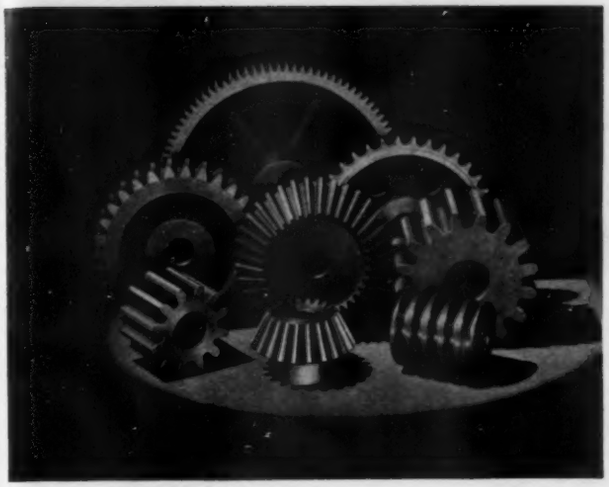
FOR SIXTY YEARS

Spur — **SPEED REDUCERS** — Worm

ALL TYPES OF CUT GEARS

GANSCHOW GEAR CO., 1007 W. Washington, Chicago



Grant Gear makers recognize that no machine can be better than its gears. For special or standard gears you will find complete satisfaction in Grant Gears and Grant service.

GRANT GEAR WORKS BOSTON

For Longer Tool-Bit Service . . .

RED-E-TOOLS

Because it is supported with a file hard half round section of tool steel which supports the cutter in front and *under* set screw.

Easily triples the life of tool bit. The guaranteed set screw will not break or mushroom on point is an added feature. Write for catalog 37A.

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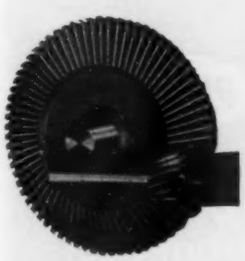

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Since 1880

HYPOIDS

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ALL TYPES • ALL MATERIALS

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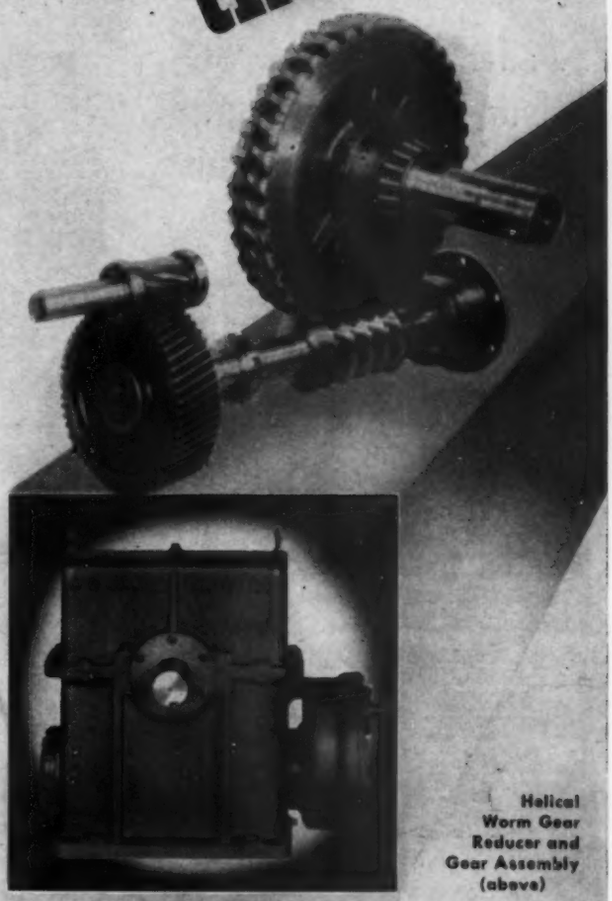

Helical Worm Gear Reducer and Gear Assembly (above)

. . . . Expertly engineered and accurately manufactured Gears, Pinions and Bearings—"That's What's in the Box."

The experience of over 50 years of Gears qualifies the D. O. James organization to manufacture all types of Gears and Gear Reducers. *May we serve you?*

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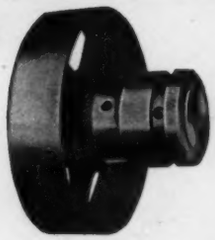
MAKERS OF ALL TYPES OF GEARS AND GEAR REDUCERS

THE JOHNSON FRICTION CLUTCH

MODERN GROUP DRIVE PTC



Left — Single Clutch with pulley.

Below — Double Clutch exterior.

. . for maximum serviceability in minimum space

The adaptability of JOHNSON FRICTION CLUTCHES to hundreds of different kinds of machines has been possible by the compactness of these sensitive, durable units.

Many leading manufacturers of industrial machinery have standardized on JOHNSON CLUTCHES because their adoption involved minimum changes in design, and assured a maximum in clutch performance.

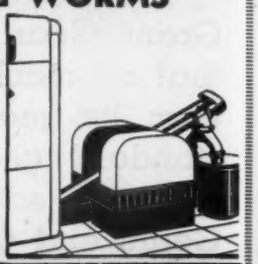
In addition to compactness, JOHNSON CLUTCHES offer quick, smooth starting. They are available for high speed on light powered drives and can be depended on for safety, durability and economy.

Let us show you how easy it is to engineer the JOHNSON CLUTCH into your machines. Just send us details of how you propose to apply the clutch. Ask for our assistance today.

Write for New 10-Page "BLUE" Clutch catalog No. 55

THE CARLYLE JOHNSON MACHINE CO. MANCHESTER CONN.

PERKINS CUSTOM-MADE GEARS and WORMS for STOKERS



Many successful stoker manufacturers rely on PERKINS CUSTOM-MADE GEARS to insure long-life, dependable service, quietness and freedom from trouble.

PERKINS makes gears of every type for stokers.

Send us your specifications. We'll gladly quote.

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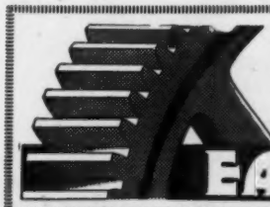

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Spur Gears—½ in. to 30 ft. in diameter
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Spur - Helical - Bevel - Worms - Screws - Racks
Gear Hobbing - Thread Milling - Broaching

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For cutting internal keyways, slots or splines 1/16" to 4" wide and up to 60" long. Fast—Accurate—Flexible. Write for particulars and catalog on machine for your work.

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IF YOU CAN USE

Standard Products

IT'S A REAL ECONOMY FOR YOU

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Ruthman Gushers

A Ruthman Gusher helps this multiple-spindle drill press maintain high production on large pipe, condenser and sea-chest connections in the Brooklyn Navy Yard machine shop.

Brooklyn has its "Gushers" Too!

Model No. 11022 Pump. Bracket type with external discharge

The present naval expansion program permits no compromise with obtaining the highest degree of efficiency from machine tool operations. With an unprecedented job of work facing navy yards, steady uninterrupted operation of machine tools calls for coolant pumps that will not fail to maintain efficient machine performance.

Ruthman "Gusher" Coolant Pumps will not let the Navy down. They have the reputation of delivering a dependable, voluminous flow of coolant—from a gusher to a trickle—as needed, the split second it's needed.

Ruthman Coolant Pumps have such a high reputation for dependability they have been chosen by over 90 leading manufacturers of high production machines as a standard accessory for assuring efficient performance. Machines designed for multiple cuts, high speeds, continuous operation live up to specifications when Ruthman "Gushers" provide coolant.

Ruthman Coolant Pumps are simple in design, require no priming, are easily regulated as to volume of flow, and require no strainers as small chips and grit do not affect their efficiency.

You, too, have the same opportunity to secure the advantages enjoyed by our navy yards and leading industrial manufacturers. Write today for further facts.

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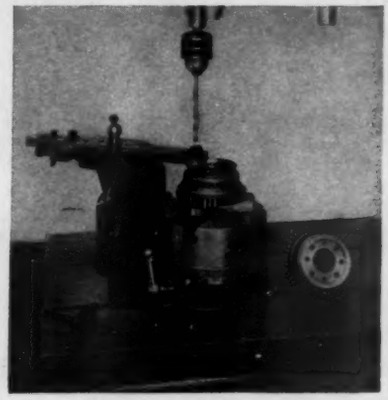
"Standard and Special Pumps for Every Job!"

The
HARTFORD SUPER-SPACER



A New, Superior Spacing Device for Rigid Control of Accurate Machining

Simple, rugged and precise, the HARTFORD SUPER-SPACER is adaptable for milling, drilling, slotting or planing operations. Only the capacity of the holding device and the power of the machine limit speeds and feeds.

Accurate indexing assured even under heavy cuts. Pays for itself on single pieces or high production runs.

When equipped with Drill Jig Attachment, the Hartford Super-Spacer will save time and money on drill jigs and layout work.

Investigate the possibilities offered on your work by writing for details.

THE HARTFORD SPECIAL MACHINERY CO.
HARTFORD, CONN.

Made of tool steel to A. S. A. Standards. Their accuracy saves drill breakage, produces better work. Made in five styles. Send for catalog B1188.

EX-CELL-O A.S.A. *Bushings*
EX-CELL-O CORPORATION • DETROIT, MICH.

ANOTHER SIGN OF GREATER INDUSTRIAL SAFETY

Fig. 1645
Pat. Applied For

Accidents do cost you money . . . and knock the spots out of production schedules as well. So, why risk the trouble that can be caused by ordinary set screws working loose. Standardize on "Unbrako" Self-Lockers. You simply tighten them up in the normal way and the ingenious knurling around the cup points takes a grip that won't be broken loose by vibration, shaking or jarring. In other words, you set them up and forget them . . . BUT, they can be easily removed with an ordinary hex bar-wrench and re-used over and over again.

Write today for samples and complete details. Test them yourself . . , we know you'll be satisfied as are the many other users in all types of industry.

Also ask us about the Self-Locking Square Head Set Screw. It has the same advantages.

Fig. 1641
Pat. Applied For

STANDARD PRESSED STEEL CO.

BRANCHES
BOSTON
DETROIT
INDIANAPOLIS

JENKINTOWN, PENNA.
Box 4

BRANCHES
CHICAGO
ST. LOUIS
SAN FRANCISCO

MAC-ITS Save on Production, Maintenance and Design!

Stronger, more accurate screws can end many tie-ups—save labor and replacements—and cut costs all along the line when your designs take advantage of their greater strength.

Mac-its give you all these savings in 16 standard items. For complete details, call your Mac-it distributor or write today for your copy of Catalog 38, listing the only complete line of heat-treated, alloy steel screws!

THE STRONG, CARLISLE & HAMMOND COMPANY
1392 West Third St., Cleveland · Ohio

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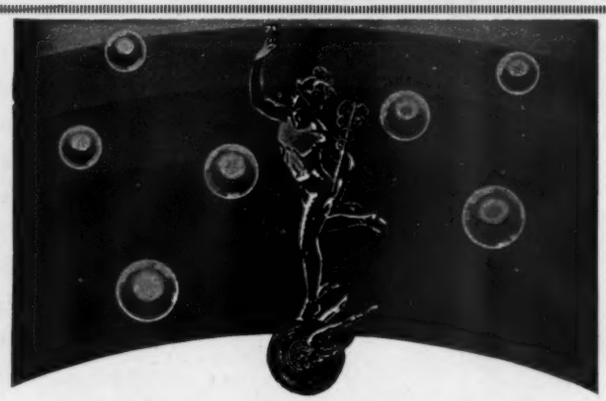
STAPLETON, STATEN ISLAND, N. Y.
MULTIPLE HEADS

Super-Sensitive Fixed-Center Multiple Drilling Heads
Fixed-Center Auto-Reverse Multiple Tapping Heads
All Parts Fully Enclosed to Insure Pressure Lubrication and Rigid Support of Adjustable Spindles
ADJUSTABLE MULTIPLE SPINDLE DRILLING HEAD



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All WATERBURY STEEL BALLS are of uniform hardness which extends to the center of each ball. Made of high carbon chrome alloy steel highly finished.

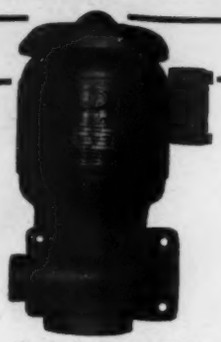
WATERBURY STEEL BALLS

HIGH CARBON, CHROME ALLOY STEEL, BRONZE, MONEL METAL, STAINLESS STEEL BALLS, STANDARD OR SPECIAL SIZES. WRITE FOR COMPLETE INFORMATION.

THE WATERBURY STEEL BALL CO., INC.
Poughkeepsie, New York
Factory: Waterbury, Conn.

CENTRIFUGAL COOLANT PUMPS

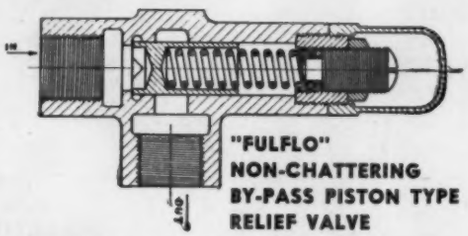
TRADE MARK "FULFLO" REG. U.S. PAT. OFF.



Vertical Type FVM

Handle Abrasive-loaded Coolant Safely-Economically

Horizontal Type FHM



"FULFLO" NON-CHATTERING BY-PASS PISTON TYPE RELIEF VALVE

For use on hydraulic systems requiring maintenance of specific pressure such as machine tool hydraulic mechanisms and presses. Cylindrical piston closes port in a shearing manner giving non-chattering operation. Available in pipe sizes from ⅜" to 1½" for pressures up to 350 lbs. in cast iron or bronze bodies with brass, steel or alloy pistons. Details on request.

These newly designed coolant pumps can be depended on to provide an abundant supply of coolant at all times and for all requirements—at low power and maintenance costs. They are completely protected against wear from handling chips or abrasive material.

Design features a pump shaft without packing and a free-floating impeller driven by a short motor shaft extension. A patented seal on pump shaft housing protects motor shaft from wear.

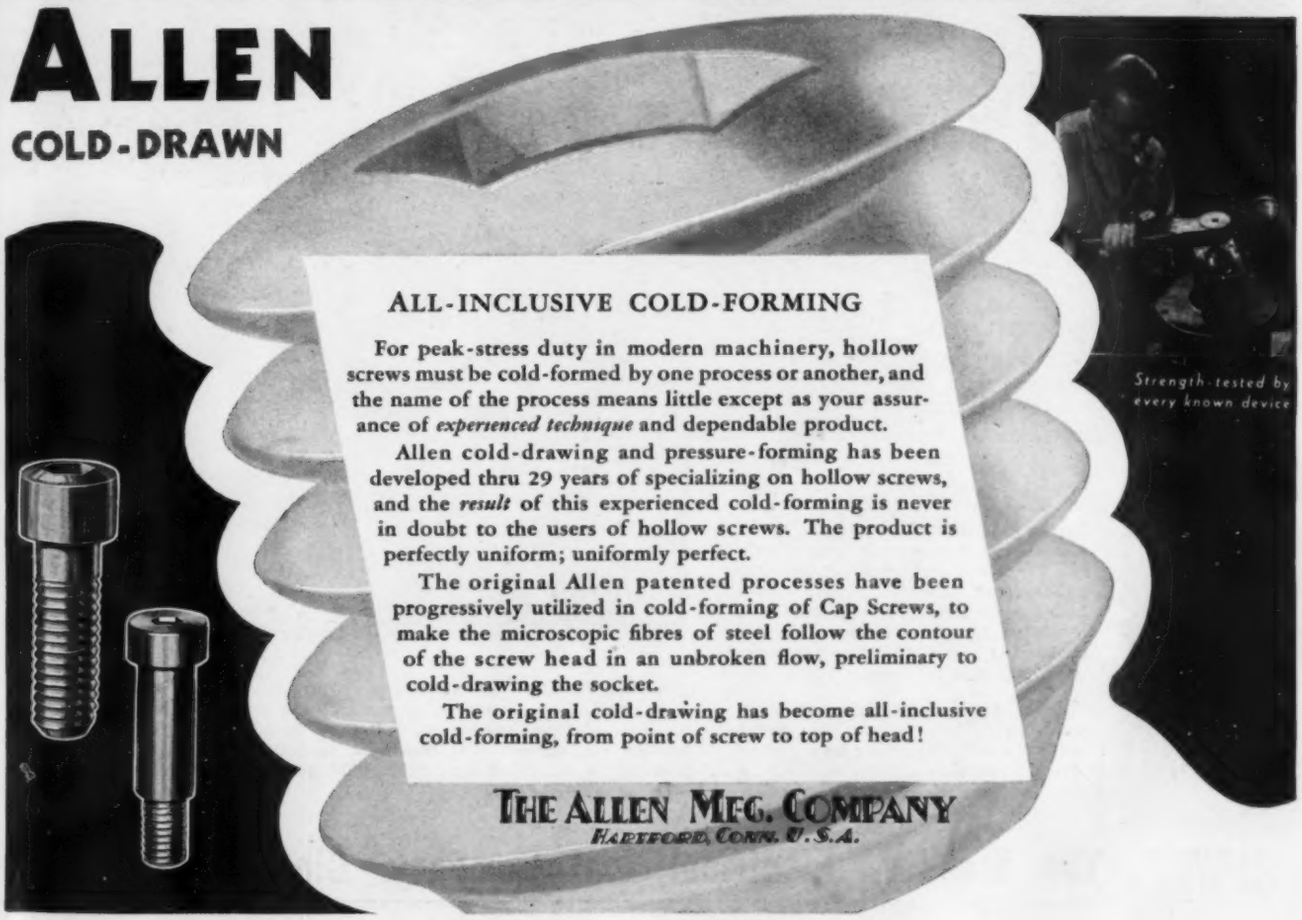
Throttling of coolant can be effected safely with motor and pump in operation.

Equipped with ¼HP Ball Bearing Splash Proof Motors. Capacity: 30 G.P.M. at 1725 r.p.m.; available for mounting in any convenient position.

Write for complete detailed information.

THE FULFLO SPECIALTIES CO., INC.
BLANCHESTER, OHIO

ALLEN
COLD-DRAWN



ALL-INCLUSIVE COLD-FORMING

For peak-stress duty in modern machinery, hollow screws must be cold-formed by one process or another, and the name of the process means little except as your assurance of *experienced technique* and dependable product.

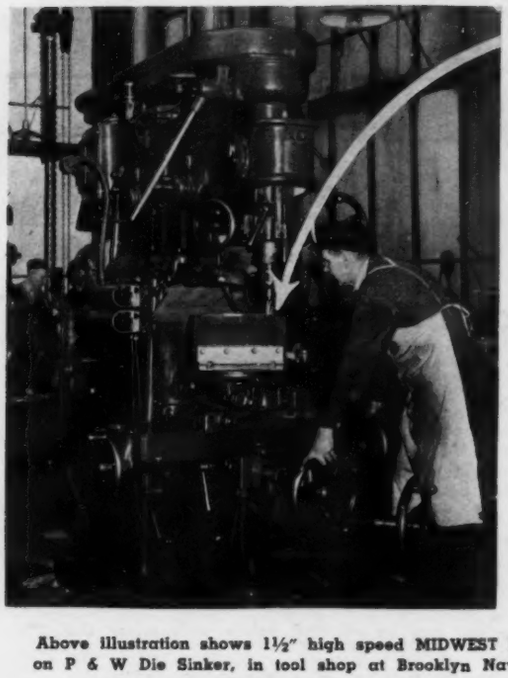
Allen cold-drawing and pressure-forming has been developed thru 29 years of specializing on hollow screws, and the *result* of this experienced cold-forming is never in doubt to the users of hollow screws. The product is perfectly uniform; uniformly perfect.

The original Allen patented processes have been progressively utilized in cold-forming of Cap Screws, to make the microscopic fibres of steel follow the contour of the screw head in an unbroken flow, preliminary to cold-drawing the socket.

The original cold-drawing has become all-inclusive cold-forming, from point of screw to top of head!

Strength-tested by every known device

THE ALLEN MFG. COMPANY
HARTFORD, CONN. U.S.A.



Above illustration shows 1½" high speed MIDWEST End Mill on P & W Die Sinker, in tool shop at Brooklyn Navy Yard

"MIDWEST" IN THE NAVY

Midwest Hi-Speed End Mills are doing dependable jobs on heavy milling operations at Brooklyn Navy Yard. They live up to their reputation for satisfactory performance under the customary high speeds and feeds of modern milling machines. In the view shown a 1½" "MIDWEST" END MILL in a Die Sinker is at work on a drop hammer die of Hartterm air-hardening die steel.

MIDWEST END MILL LINE

includes single-end and double-end HY-Helix (Fast Spiral) types, right and left hand cuts, with straight or taper shanks (either B. & S. or Morse tapers) —Shell and others, of high speed steel.

Send for your copy **BULLETIN 16B**

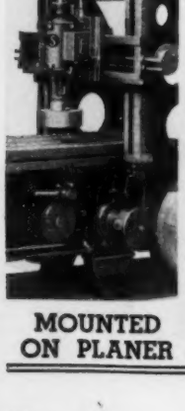
MIDWEST TOOL & MFG. CO.

2345 W. JEFFERSON AVE.

DETROIT, MICH.

STANDARD VERTICAL GRINDER

STANDARD answers the call of UNCLE SAM to modernize and maintain The Fleet



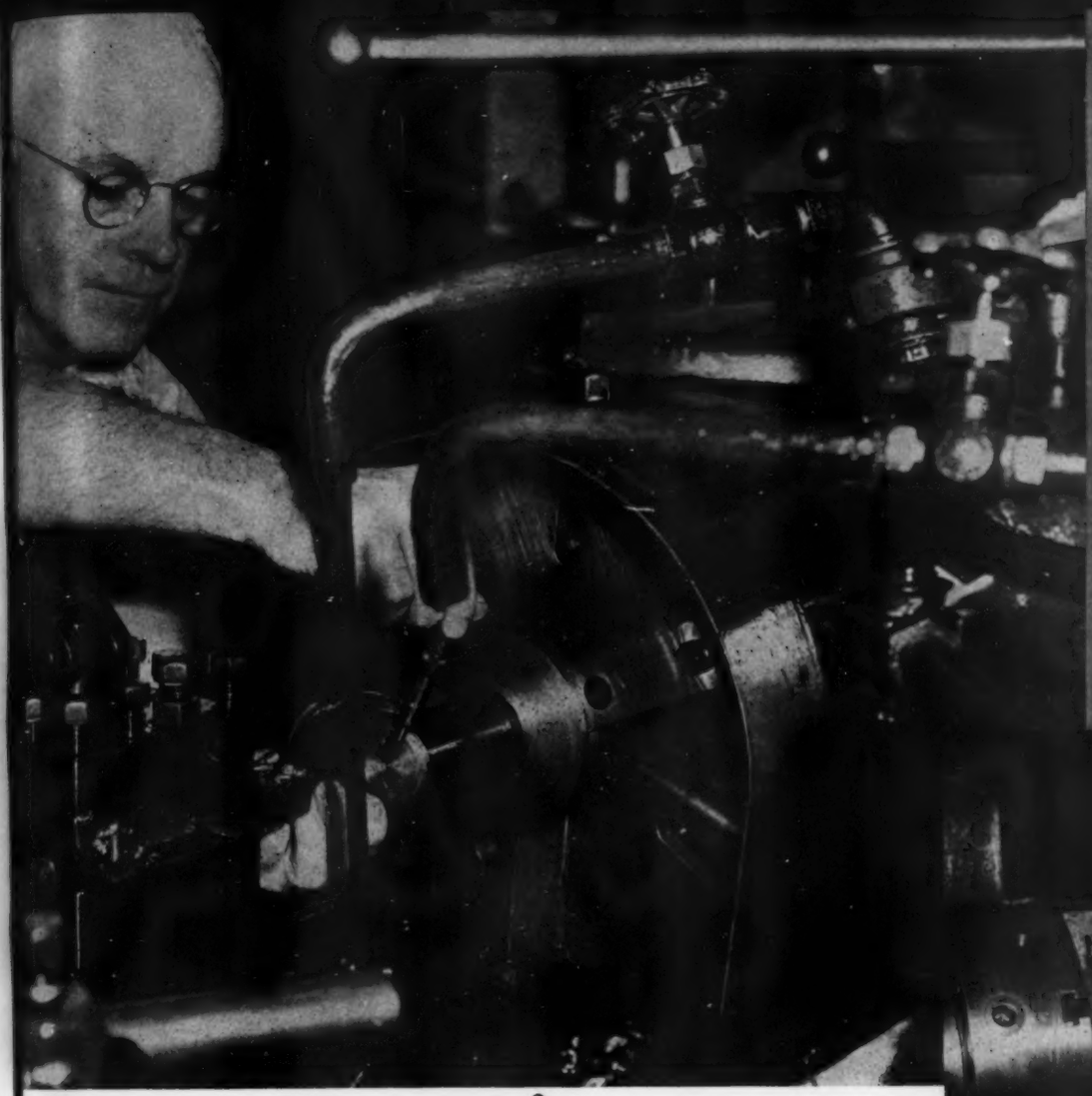
MOUNTED ON PLANER

During the Nation's greatest expansion program, now underway, Brooklyn has been assigned the work of building and repairing naval vessels, building Diesels, and manufacturing a wide variety of ordnance. We are proud that STANDARD Grinders have a part in this program.

Illustrations show a Standard Vertical Angle Plate Grinder on boring mill re-machining the bore of a forged propeller shaft coupling in shop at Brooklyn Navy Yard.

Standard Grinders withstand heavy thrusts while grinding at any angle, from horizontal to vertical—on boring mills, lathes, planers, milling machines. Heavy thrust bearings guard against end thrust. Oil chambers so built as to prevent oil leakage. 1 hp. to 15 hp.; 1200, 1800, or 3600 r.p.m. Available with or without feeds.

The Standard Electrical Tool Company, Cincinnati, Ohio



Slocomb micrometer checking 1½" Steel Forging being machined at Brooklyn Navy Yard.

Testing a gear blank at Pratt & Whitney aircraft plant with a Slocomb micrometer.

SLOCOMB MICROMETERS

check tolerances for mobilized industry • • • • •

J. T. SLOCOMB COMPANY, PROVIDENCE, RHODE ISLAND, U. S. A.

SLOCOMB MICROMETERS ARE USED ALL OVER THE WORLD. REG. U.S. PAT. OFFICE

NO. 28 MICROMETER SET—2" to 24"

CENTER DRILL—Carbon or High Speed Steel

Combination Center Drill—Carbon or High Speed Steel

Bell Type Combination Center Drill—Carbon or High Speed Steel

NO. 22 ½" MICROMETER

WRITE FOR COMPLETE CATALOG OF SLOCOMB MACHINIST'S TOOLS

American Swiss Files of Precision

Filing the edges of a small part for use on airplane motors—an operation in the Pratt & Whitney Aircraft plant calling for careful, precise work—the kind of work for which American Swiss Files are admirably suited.

Aircraft Production and Navy Requirements Demand Sustained Precision of Parts

The use of American Swiss Files in the Pratt & Whitney Aircraft plant and in the Brooklyn Navy Yard are evidence that these shops recognize the fact that the better the tool, the better and faster a good man can work.

In every branch of the metal-working industry American Swiss Files are known for their long life and low filing costs.

With more than 2500 regular shapes, cuts and sizes available from which to choose, you, too, can be certain of selecting the ones best suited to your work.

American Swiss Pattern Files are the only type we manufacture.

Send for catalog and price list.

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American Swiss File and Tool Co.

Elizabeth, New Jersey

TRADE FILES ONLY THE BEST ARE GOOD ENOUGH MARK TOOLS

Swiss Pattern Files are made in the United States of America

American Swiss Files are being used by this toolmaker in the Brooklyn Navy Yard for filing a forming tool for valve discs for war vessels.

THE NEW FACTORY AND GENERAL OFFICES OF CARBOLOY COMPANY, INC.

We announce the opening of our new factory and general offices at Detroit, Michigan, combining all research, manufacturing and general administrative units formerly located at Cleveland, Detroit, and Stamford, Connecticut.

The Mark of CARBOLOY
REG. U. S. PAT. OFF.

These new facilities represent an investment made to meet certain requirements that we feel are vital to the sound growth of this industry. They provide for the development of a progressively higher order of economy—and initiate a program that should result in a more comprehensive use of cemented carbides throughout industry.

This new plant, embodying existing facilities for producing approximately 10 times the present amount of cemented carbide currently consumed by industry, with ample reserve space, is not only the *largest source of cemented carbide in this country*, it is a promise of far greater benefits to industry in the future than have been possible in the past.

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(A complete descriptive brochure available for executives on request.)

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Small Tools are Tested at Springfield Arsenal

● Two "ROCKWELL" Hardness Testers are used in the Hill Shop of the Springfield Arsenal for testing small tools made in this plant:

Other fabricating shops in the War and Navy Departments make extensive use of "ROCKWELL" machines for testing brass and other non-ferrous metals in sheet, tube and various forms.

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With and Without Jig Attachments.
Jaws 6", 9" and 12" Long
Often used on Miller, Shaper, Planer

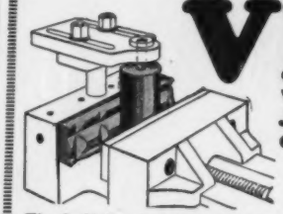
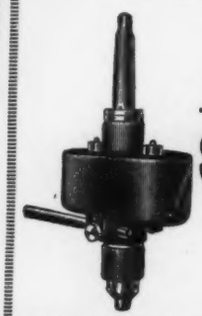


Fig. 3. V-Jaw for Round Work

Attachments mean much drilling — small Jig cost.

Fig. 2 Without Jig Attachments



DRILL
SPEEDER

or High Speed Drilling Attachment
Drives Small Drills up to Proper Speed
INCREASE THE SPEED 3 TIMES
Suits Straight or Taper Shank Drills up to ½" with Speeds to 3,000 R.P.M. For use in Drillers from 20" to largest Radial.

KNURL HOLDER

Swivel Lugs

Shank made to suit turret

For Turret Lathes
Operates like screw Die
Adjustable to any size within its capacity.

TWO SIZES--TWO STYLES
Straight Cut Knurls in Swivel Lugs Produce all Standard Knurling.

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A SAFE WRENCH
For Use In Perilous Positions

The FAVORITE Reversible Ratchet Wrench

Has a head that completely surrounds and covers the nut; the bolt passes clear through the head. These features are more appreciated than ever when working in dangerous places.

Consult your jobber, or write for full information.

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Sole Manufacturers
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Armament Orders Call For Efficient Tools . . .

BE PREPARED - - Modernize Now!

IN your own interest, be familiar with the best available metal-cutting tools, and start your modernization program, well in advance of the actual need. Don't wait until your firm receives its armament assignment. Also, in your own interest, begin with an examination of the O K System—the preferred equipment in an important percent of the progressive metal-working shops of the country.

O K Inserted-Blade Metal-Cutting Tools meet the most exacting requirements of the manufacture of defense equipment. They promote speed and economy along with the utmost accuracy. In the multiple cutters, above, the blades are driven into serrated mating slots in the body. There they lock automatically and positively, without the use of wedges, pins or set-screws—yet are instantly adjustable in line of wear. The Single-Point Tools embody various locking designs. Shown at the right are Series 2000, in which the bits are held in mated serrations, and Series 0-200, in which round-shank bits are locked in a drop seat. Others may be seen in the latest O K catalog, sent on request.

In all O K Tools, the bodies are of chrome nickel steel, forged and heat treated for maximum strength. The blades and bits are supplied in high-speed steel, Stellite, and Super-Cobalt steel, and with special carbide tips.

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Detail of Blade Adjustment

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Series O-200

Series 2000

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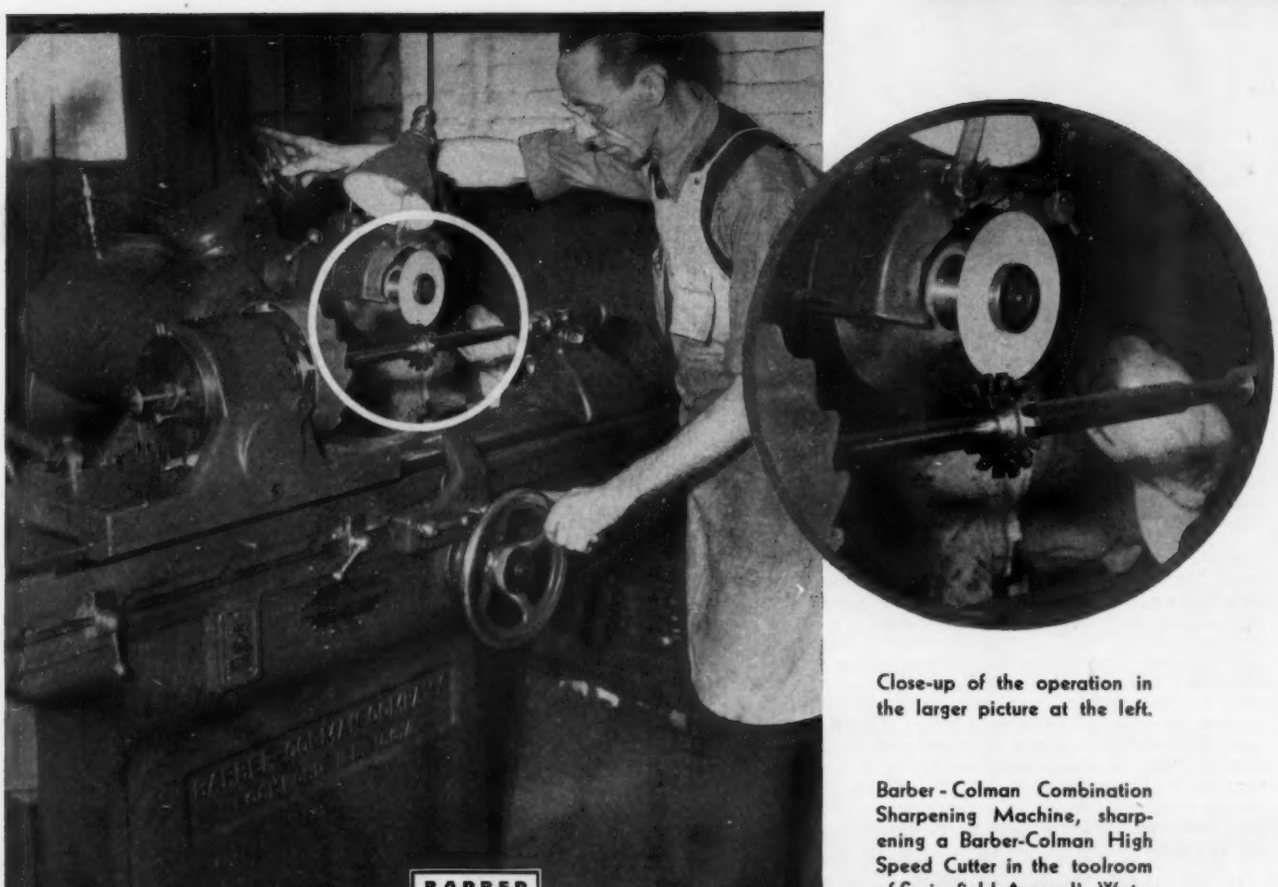
INSERTED-BLADE METAL CUTTING

TOOL SYSTEM

THE



Close-up of the operation in the larger picture at the left.

Barber - Colman Combination Sharpening Machine, sharpening a Barber-Colman High Speed Cutter in the toolroom of Springfield Arsenal's Water Plant. A duplicate machine installed at the Hill Plant as well.

BARBER
B-C
COLMAN
PRODUCTS

HOBS, HOBBING MACHINES, HOB SHARPENING MACHINES, REAMERS, REAMER SHARPENING MACHINES, MILLING CUTTERS, SPECIAL TOOLS

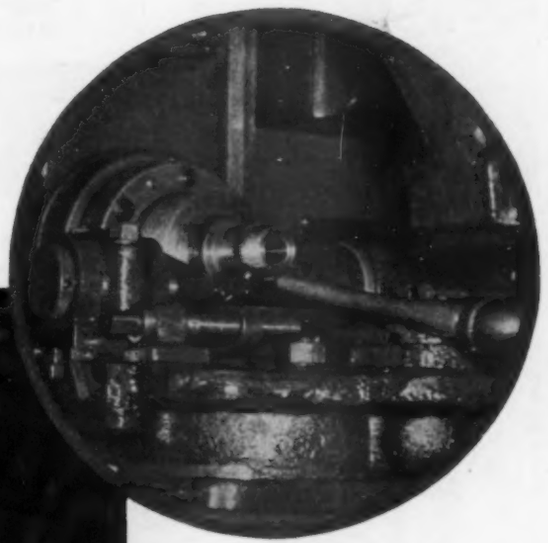
HIGHER PRODUCTIVE SPEED, GREATER ACCURACY, BETTER DESIGN, CAUTIOUS FOREHANDEDNESS—ELEMENTS IN THE MOVEMENT TO STIFFEN THE NATION AND MAKE PEACE SECURE THROUGH *READINESS* TO *"GO OVER THE TOP."*

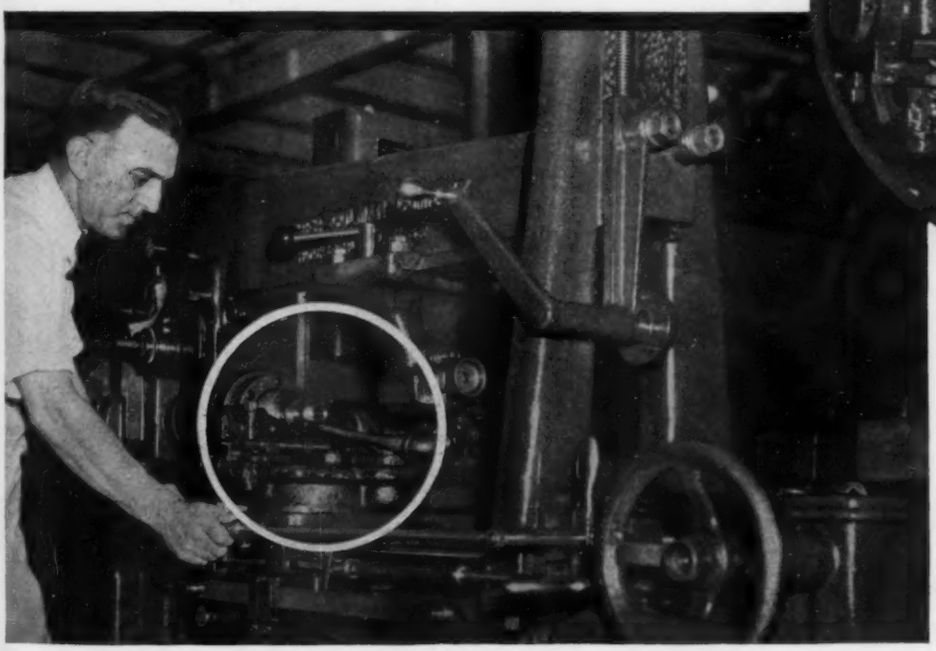
BARBER-COLMAN

ARMY

GIRDS FOR PEACE *at Springfield*

Never before in the whole history of America's Military Might has technical development been so important as at this moment, when the best of the world's engineering brains are applying themselves to military and naval betterment. It is significant that Barber-Colman precision machine tools do so much of the *important* work and are being installed in constantly increasing numbers. Descriptive printed matter that discusses Barber-Colman tools in detail await your request. Send for it today.



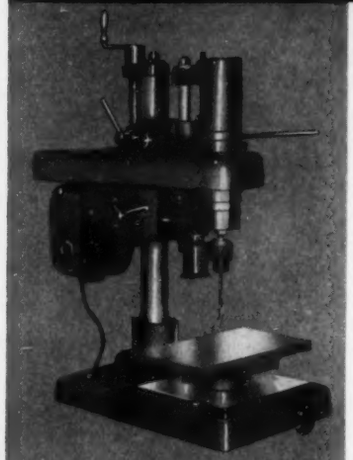


Serrating the end of a gun barrel on a Barber-Colman Type A Hobbing Machine, at the Water Plant of Springfield Arsenal.

COMPANY

General Offices & Plant
ROCKFORD, ILL., U.S.A.

No National Defense Machine is Better than its Parts . . . . .



MAXI-Jr.-E. SUPER
SENSITIVE DRILLING MACHINE

Holes from .004" to ⅛" . . . Speeds from 750 to 12,000. Head swings radially about column. Maximum distance base to chuck, 10" . . . center of chuck to column, 5". Also other sizes.

THAT IS WHY THIS PAIR OF HAMILTON-MUEHLMATT MACHINES IS NEEDED BY LEADING PARTS MAKERS!

Manufacturers of aerial cameras, deisel engines, airplane parts and instruments, gyroscope equipment and other allied armament products find these machines indispensable for drilling and tapping the smallest holes with speed and accuracy.

Government arsenals, aircraft shops and torpedo stations have found that Hamilton-Muehlmatt Super-Sensitive Drilling and Tapping Machines solve their most difficult drilling and tapping problems in an entirely satisfactory manner.

If you have holes to drill within a range of .004" to ¼", or tapping from the smallest and finest threads to 10–32—and are interested in the elimination of drill and tap breakage—write us for complete information.

THE WORLD'S STANDARD IN SUPER-SENSITIVE DRILLING AND TAPPING EQUIPMENT!

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SENSITIVE TAPPING MACHINE

Taps from smallest and finest to 10-32 . . . Spindle speeds 1200 to 2600. Head travels 1" vertically. Distance from chuck to round table, 3½" . . . chuck to rectangular table, 3⅛" . . . center of tables to column, 3¼".

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Two Precision Tools in One!

By merely adding base and scriber, this vernier caliper becomes a height gage. A tool priced within your reach. Every toolmaker should have one. Every toolroom needs several.

SERVICE: Using this tool as a vernier caliper you can measure inside, outside, root, in 1/1000", in 1/128"; as a height gage for laying-out, scribing, etc., up to 7, 9 or 11 inches. YOU CANNOT DUPLICATE THIS VALUE.

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MAUSER COMBINED HEIGHT GAGE AND VERNIER CALIPER SHOWN ABOVE

Model number	613R	614R	615R
Measuring capacity	7"	9"	11"
Verniers giving readings in 1/1000" & 1/128" —also knife edge points	$19.25	$21.50	$25.50

DEALERS: Mauser precision tools are in daily use in shops from coast to coast. A complete line priced from $4.25 to $27.50. Hundreds in your territory are waiting for these tools. WRITE FOR DEALERS' TERMS.

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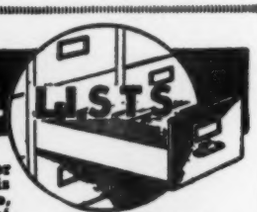

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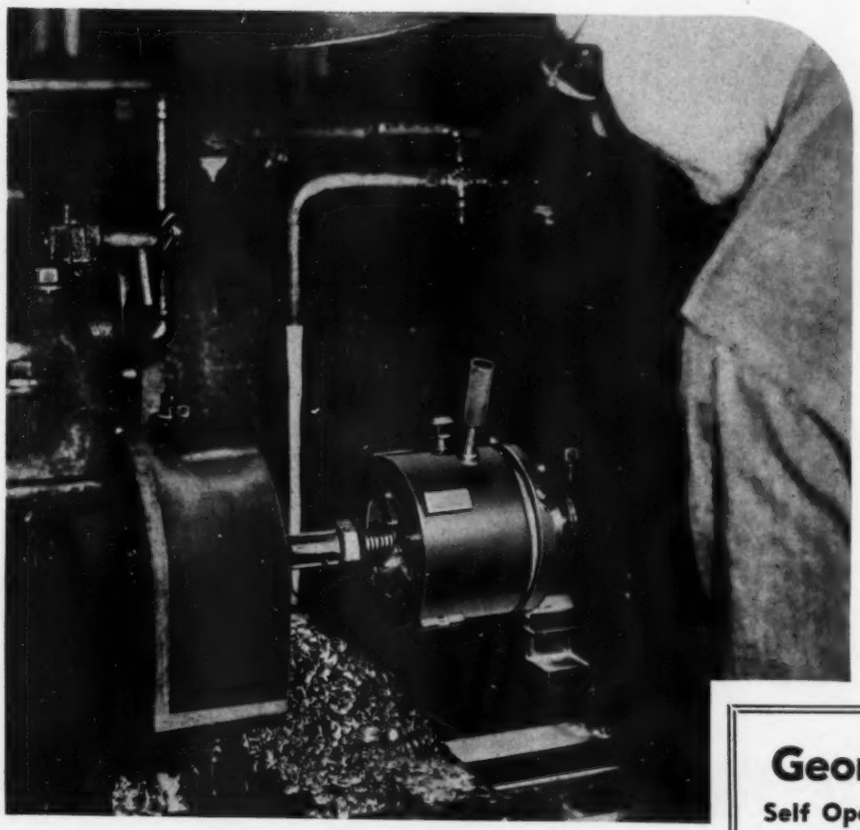
Right in the Lead

Whether your threading be garden hose nozzles or shells; tractor parts or aeroplane parts; parts for row boats or parts for battleships; you'll find Geometric Tools and Geometric Chasers right in the lead.

To-day the talk is of weapons for defense. The picture below shows a Geometric Die Head in the shops of the Brooklyn Navy Yard where it is proving its ability to maintain the fast pace demanded for economically produced, accurate threads.

This is but one of the thousands of Geometric Tools being employed for national defense, either in the shops of the Navy Yards or Arsenals or in private shops on government work.

Can we show you how Geometric Tools can be used to produce your threads better and at lower costs?



A Geometric Die Head cutting 1" threads on drop forged steel valve parts at a spindle speed of 38 R.P.M. on a turret lathe in the Brooklyn Navy Yard.

GEO MET RIC

THE GEOMETRIC TOOL COMPANY

NEW HAVEN, CONN.

Specialists in tools for producing screw threads since 1895

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Self Opening Die Heads
Solid Adjustable Die Heads
Taper Cutting Die Heads
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Solid Adjustable Taps
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Precision Threading Machines

BODY HARDENED AND GROUND THROUGHOUT including TAPER HOLE
NEW BETTER-GRIP SLEEVE Easy on the Operator's Hands
SLEEVE INTERNALLY GROUND ON 3 DIAMETERS for Perfect Balance
BALL BEARINGS ELIMINATE FRICTION For Quick, Smooth Operation
REMOVAL OF SCREW CONVERTS CHUCK TO HOLLOW MODEL
NEW NICKEL MOLYBDENUM ALLOY STEEL JAWS and NUT
ATMOSPHERICALLY CONTROLLED HEAT-TREATMENT OF JAWS, NUT AND SLEEVE
No 14

You Get the 4 Chucking Essentials

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THE JACOBS MANUFACTURING COMPANY

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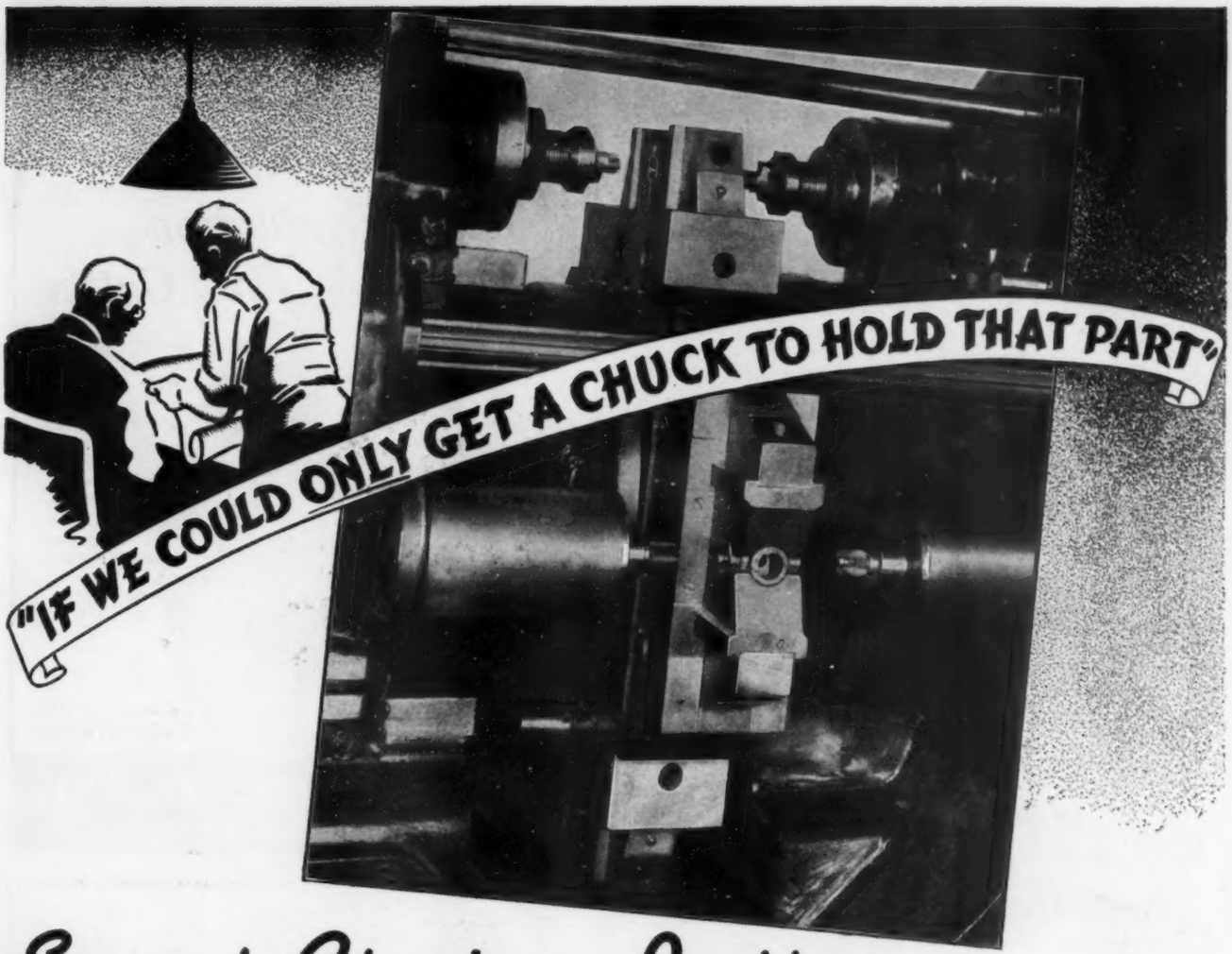

Special Chucking Problems

Find quick solution in the CUSHMAN ENGINEERING DEPARTMENT

Many leading plants throughout the country regularly call upon The Cushman Engineering Department for help in the solution of special production problems, where extreme accuracy of machining is essential, but where competition demands highly efficient production.

In the above illustration, for example, special steel body 2-jaw chucks were developed for a production machine in a large manufacturing plant. Here four chucks are mounted on an indexing carrier to bring the work pieces to each station — the chucking and releasing are accomplished by built-in power equipment and each chuck is dust proof to provide long service life.

The extreme accuracy of the chucks themselves plus automatic power operation, cut production time on this job to a minimum while producing work of high and consistent quality.

On your next Special Chucking Problem consult The Cushman Engineering Department — the more difficult the problem the more valuable they can be to you.

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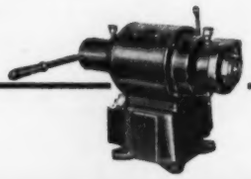
A world standard for **PRECISION**

CHUCKING ENGINEERS *Since 1862*

SPRINGFIELD ARSENAL *saves* on .50 cal. barrels

That final, all-important operation—that tricky smoothing of the *inside* of the barrel, to ease and hasten the bullet on its way—*that* is the function of the Schauer type NA2B Ideal Speed Lathe, shown here at the Hill Shop of the famous arsenal.

These simple, effective little machines, used for lapping, finishing and polishing small parts, are described fully in circular 380. Write for it.



SCHAUER MACHINE CO.

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WALKER MAGNETIC CHUCKS

A High Production Cost Cutter

Powerful, Rigid and Accurate. Quick adjustments. Handles a wide range of work. Set-up time reduced to a minimum through use of Walker Rotary Magnetic Chuck, which is automatically magnetized and demagnetized. Illustration shows Type D-B Capacity, work up to 12″ diameter, 4″ high, under a new grinding wheel.

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Unless otherwise specified, are fitted to cylindrical sub-presses as illustrated. They are made either plain, compound, or tandem as the nature of the part requires or the customer requests. Our forty years of successful operation has given us the experience and data necessary to produce satisfactory results. Send your samples and drawings for suggestions and prices

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WALTHAM MACHINE WORKS
HIGH STREET . . . . WALTHAM, MASS.

The DALRAE MIDGET MILL

DALRAE MIDGET MILL attached to milling machine head in the Brooklyn Navy Yard shops. Correct speed is provided by the ¾" cutter used in machining holes in a catch plate or screen.

does its bit for Uncle Sam—

BY providing the proper speeds for highest efficiency in boring, drilling and milling, the DALRAE MIDGET MILL is a big help in assuring accuracy, speed and low cost on work assigned to it at the Brooklyn Navy Yard.

By using its screw feed, the Midget Mill will handle the boring of smooth holes to close precision limits. A new "Thou-Meter" —accurate to ±.00025—for depth of bore enables working to exact depths without interrupting work.

The DALRAE MiDGET MILL—for boring milling and drilling—can be fitted easily to the overarm of any milling machine. Only one set-up is required for any compound angle.

Get all the facts today by writing for the new DALRAE Booklet.

DALRAE TOOLS CO. SYRACUSE NEW YORK

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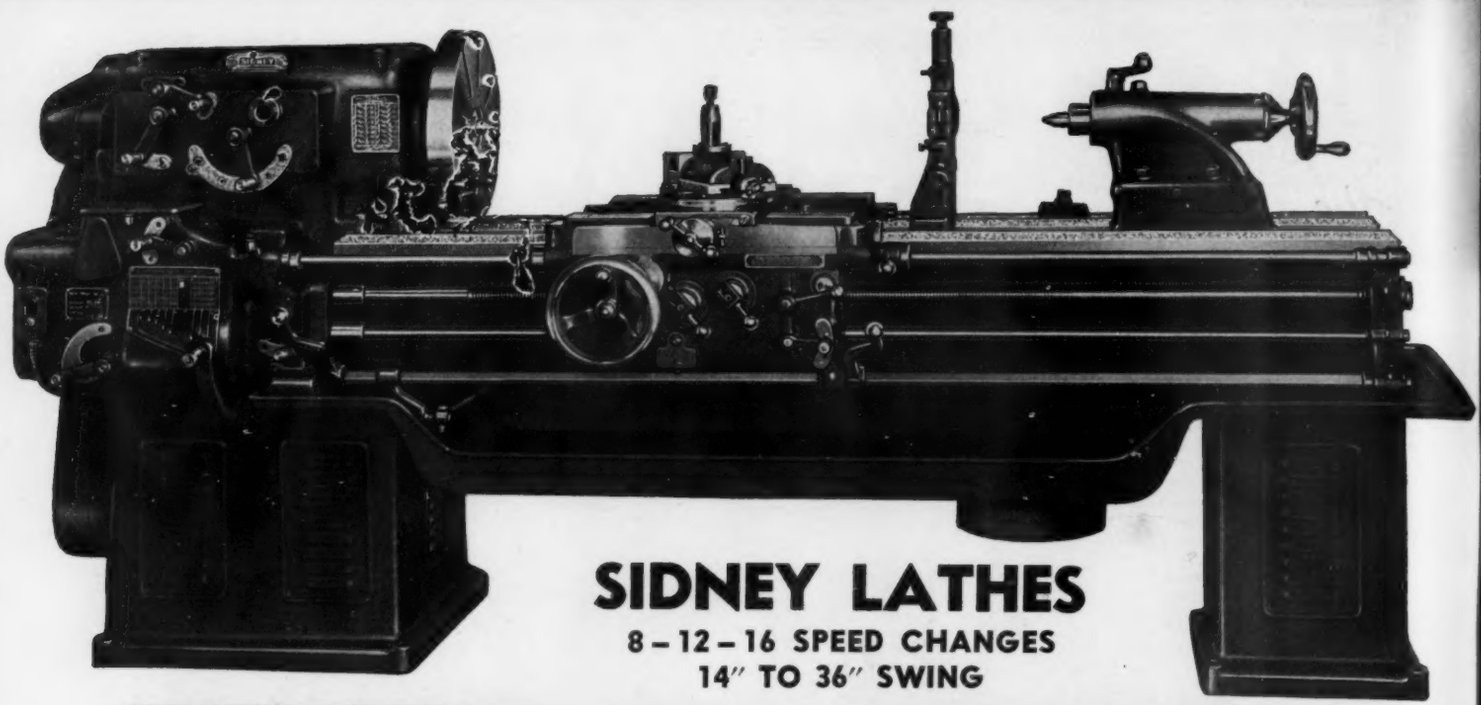
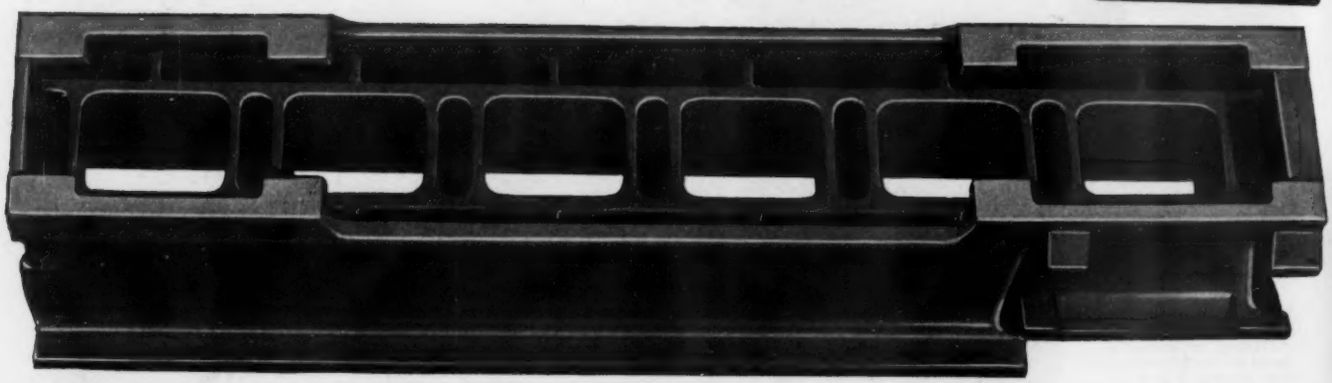
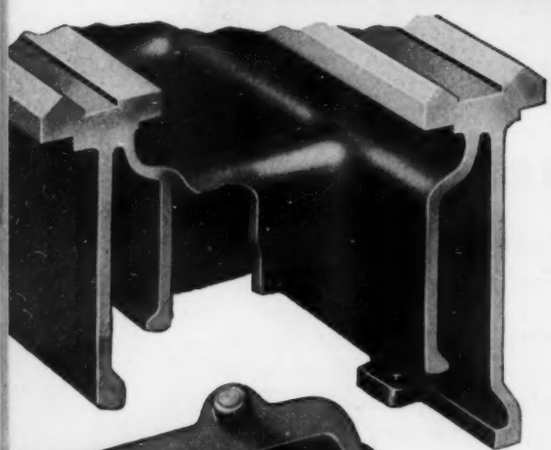


SIDNEY LATHES

8 – 12 – 16 SPEED CHANGES
14″ TO 36″ SWING





1. Note the Headstock Construction. More tooth contact with continuous tooth herringbone gears—and greater strength, smoother action, and end thrust eliminated through the opposite helix angle. Sixteen spindle speeds in geometric progression. Alloy steel forgings for gears—hardened—teeth lapped under pressure.

2. Note Internal Tooth Gear Clutch Construction. Internal and external teeth are cut on gear shapers with the same accuracy accorded transmission gears. Design reduces backlash to a minimum. Splined shafts and alternating relief on clutch teeth assure easy engagement.

3. Note Bed Construction. Four walls, with cross girts at 12″ intervals. Scientifically resists deflections and twisting strains. Note generous area of outside V ways, inside V way and flat way for control of accurate head and tailstock alignment.

Sidney Lathes are truly designed for ACCURATE PERFORMANCE! FULL particulars in newly published Bulletin.

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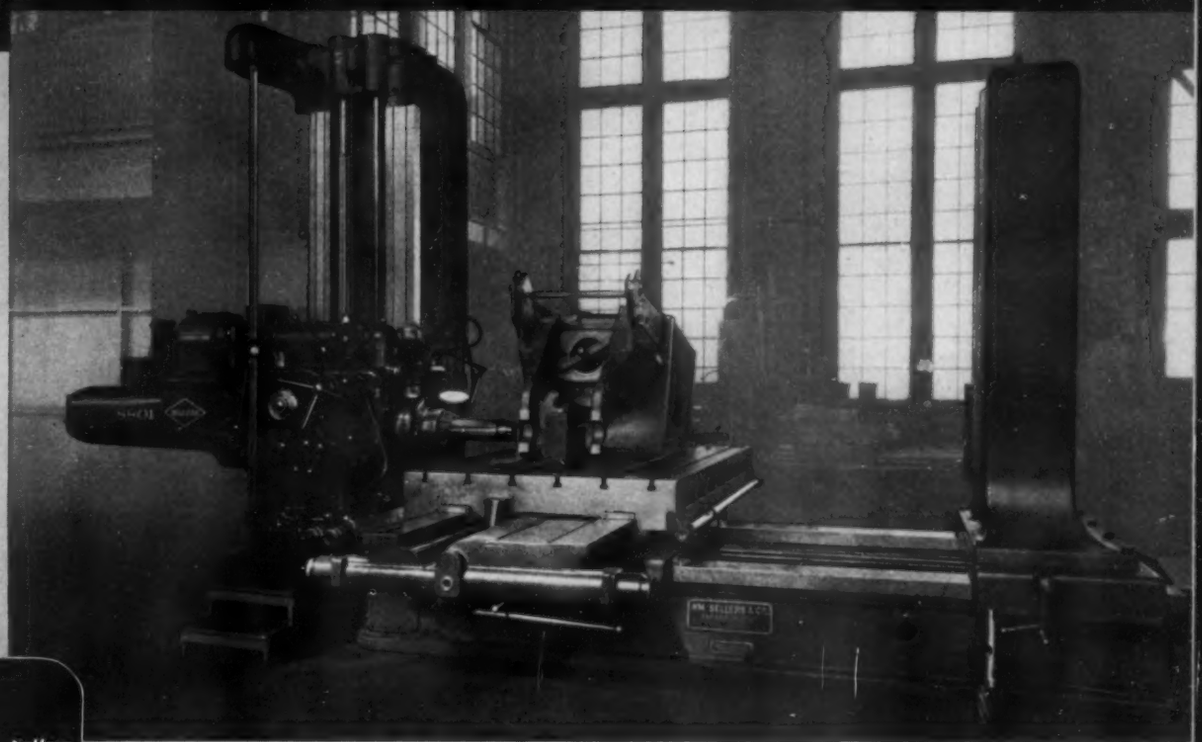
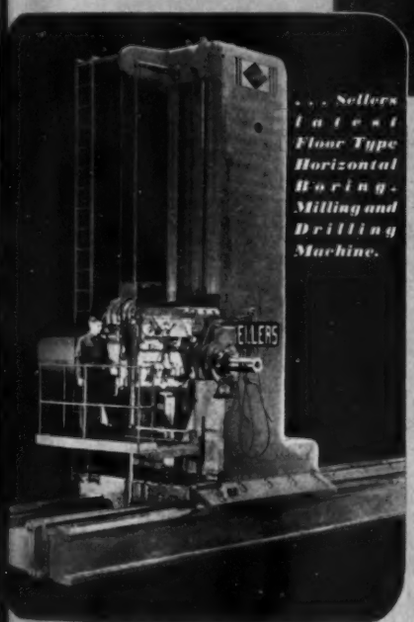
Demanded by the Army . . .

. . . Assured by Sellers



. . . This Sellers 5-in. Horizontal Boring, Milling and Drilling Machine in operation machining a welded top carriage assembly for a 3-in. anti-aircraft gun at York Safe & Lock Co., York, Pa.



. . . Sellers latest Floor Type Horizontal Boring, Milling and Drilling Machine.

MORE flexible control, more accurate work, heavier cuts, increased production capacity, greater adaptability . . . all these are inherent characteristics of Sellers Horizontal Boring, Milling and Drilling Machine — made possible by such features as the Sellers Unit Head, combining motor and spindle in one unit with centralized controls, the heavy-duty Sellers Bed and the sturdy box-section construction of the Sellers Column, Saddle and Table. Write today for information about Sellers complete line of machine tools.

WILLIAM SELLERS & COMPANY, Inc.

1600 Hamilton Street · Philadelphia, Pa.

FOUNDED SELLERS 1848

Sellers

HENDEY LATHES

IN THE TOOL ROOM OF THE SPRINGFIELD ARMORY

These new 12" x 30" HENDEY PRECISION GEARED HEAD LATHES—just set up at the time the photograph was taken—will be used in turning out the fine quality tool work for which Hendey machines have been universally known over a period of many years.

Regardless of the requirements—whether for toolroom or production—for military, naval or industrial service—Hendey Lathes and Shapers can be depended on for more and better work at lower cost. There are types and sizes for your needs, fully described in bulletins available on request.

THE HENDEY MACHINE COMPANY
TORRINGTON, CONN., U. S. A.

BOSTON NEW YORK ROCHESTER DETROIT CHICAGO

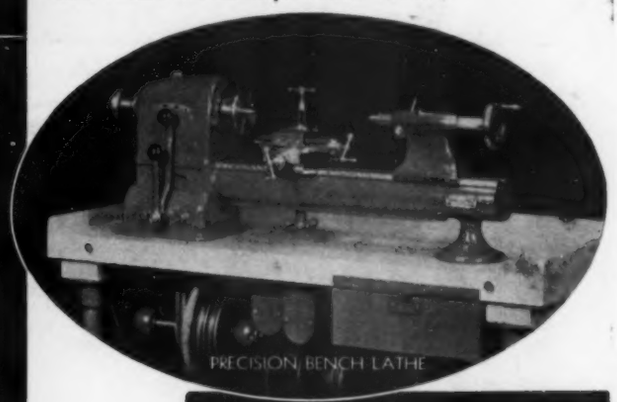
PRECISION TOOL ROOM LATHE

PRECISION HAND SCREW MACHINE

Follow THIS TREND *SET BY* HARDINGE

Extensive use of Hardinge Precision Lathes, Screw Machines and Milling Machines by various U. S. Government Departments is indicative of the acceptance of Hardinge logic that Small Machines should be used for Small Work.

Investigate the possibility of these machines on your work. Hardinge offers you the means of attaining new standards for accuracy, speed and finer results on small precision work.



PRECISION BENCH LATHE

PRECISION MILLING MACHINE

U. S. Government Departments Which Purchased Hardinge Machine Tools in 1937, 1938, 1939.

DEPARTMENT OF COMMERCE

Bureau of Census, Washington, D. C. . . . Bureau of Air Commerce, Washington, D. C. . . . National Advisory Committee for Aeronautics, Langley Field, Va.

WAR DEPARTMENT

Fairfield Air Depot, Osborn, Ohio . . . Fort Sam Houston, San Antonio, Texas . . . Frankford Arsenal, Frankford, Pa. . . . Hawaiian Ordnance Department, Honolulu, T.H. . . . Air Depot, Sacramento, Cal. . . . Wright Field, Wright, Ohio . . . Springfield Armory, Springfield, Mass.

NAVY DEPARTMENT

Fleet Air Base, Coco Solo, C. Z. . . . Naval Air Station, Anacostia, D. C. . . . Naval Air Station, Pensacola, Fla. . . . Naval Aircraft Factory, Philadelphia, Pa. . . . Naval Gun Factory, Alexandria, Va. . . . U. S. Navy Yard, Washington, D. C. . . . Naval Research Laboratory, Bellevue, Anacostia, D. C. . . . Naval Torpedo Station, Keyport, Wash.

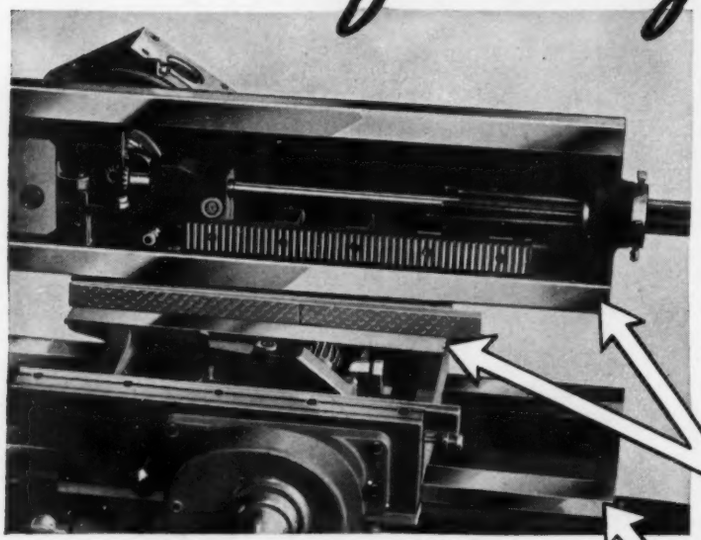
FOR SHIPBOARD USE

U.S.S. DOBBIN . . . U.S.S. HOLLAND . . . U.S.S. DIXIE . . . U.S.S. PRAIRIE.

HARDINGE BROTHERS, INC., ELMIRA, N. Y.

CHICAGO · NEW YORK · PHILADELPHIA · DETROIT · HARTFORD

The Life Long Accuracy



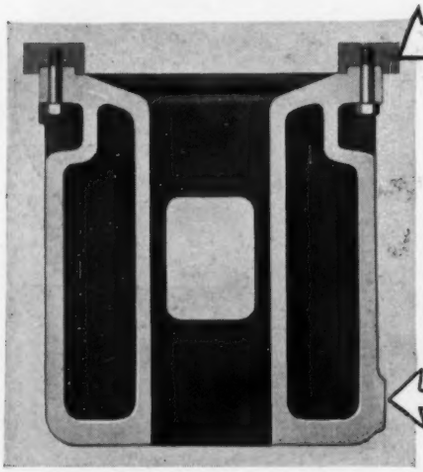
BUILT INTO

BARDONS & OLIVER No. 5 *and* No. 7 UNIVERSAL TURRET LATHES

is essential for Interchangeable Manufacturing

In high production industries where interchangeability of parts is a vital necessity, the original accuracy of a Turret Lathe must be maintained.

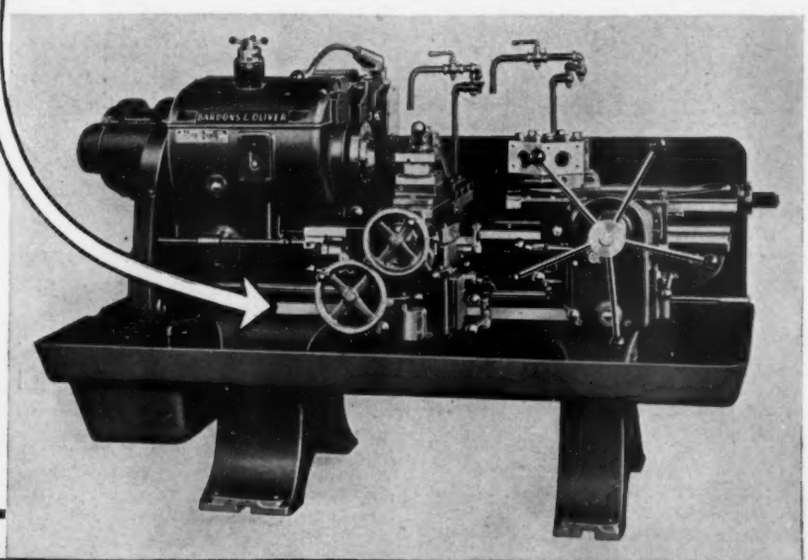
THE HARDENED ALLOY STEEL WEAR PLATES on the bottom of the turret slide riding on similar wear plates in the saddle insure durable alignment between turret holes and spindle center.



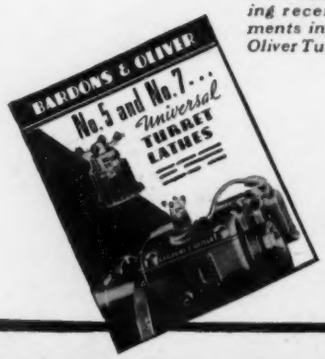
THE HARDENED STEEL BED WAYS present three hard wear-resisting surfaces unbroken by holding down screws or pins. The tongue and groove construction together with alloy steel studs anchor the ways rigidly and permanently to the bed.

THE THIRD WAY in combination with a hardened and ground steel gib underneath the rear bed way lends increased rigidity to the cross slide and greatly decreases the effort required to traverse the carriage on the bed.

We build a complete line of ram type turret lathes.



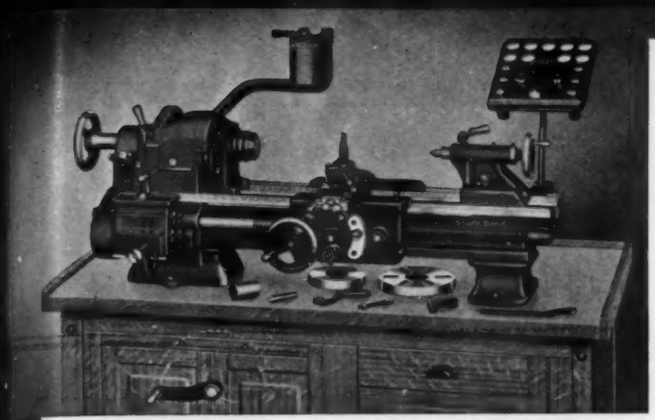
One of a series of advertisements featuring recent developments in Bardons & Oliver Turret Lathes.



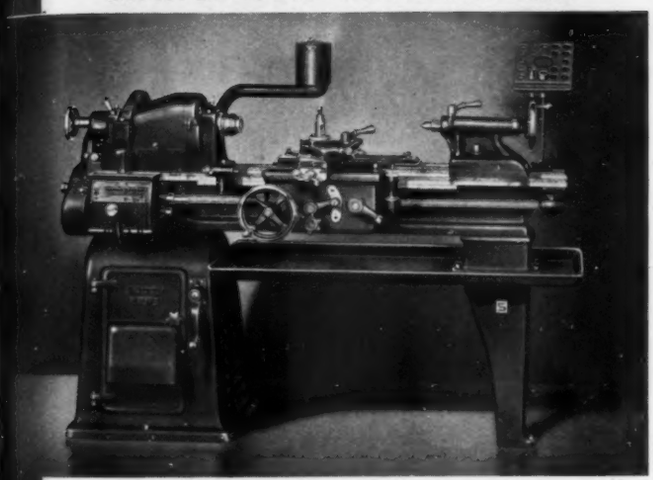
Write for your copy of this circular.

BARDONS & OLIVER, INC.

1133 W. 9TH ST. . . CLEVELAND, OHIO



9-inch 1″ Collet Capacity Underneath Motor Drive Precision Bench Lathe



13″ x 5′ Underneath Motor Drive Tool Room Lathe

SOUTH BEND LATHES

A Modern Lathe at a Moderate Price

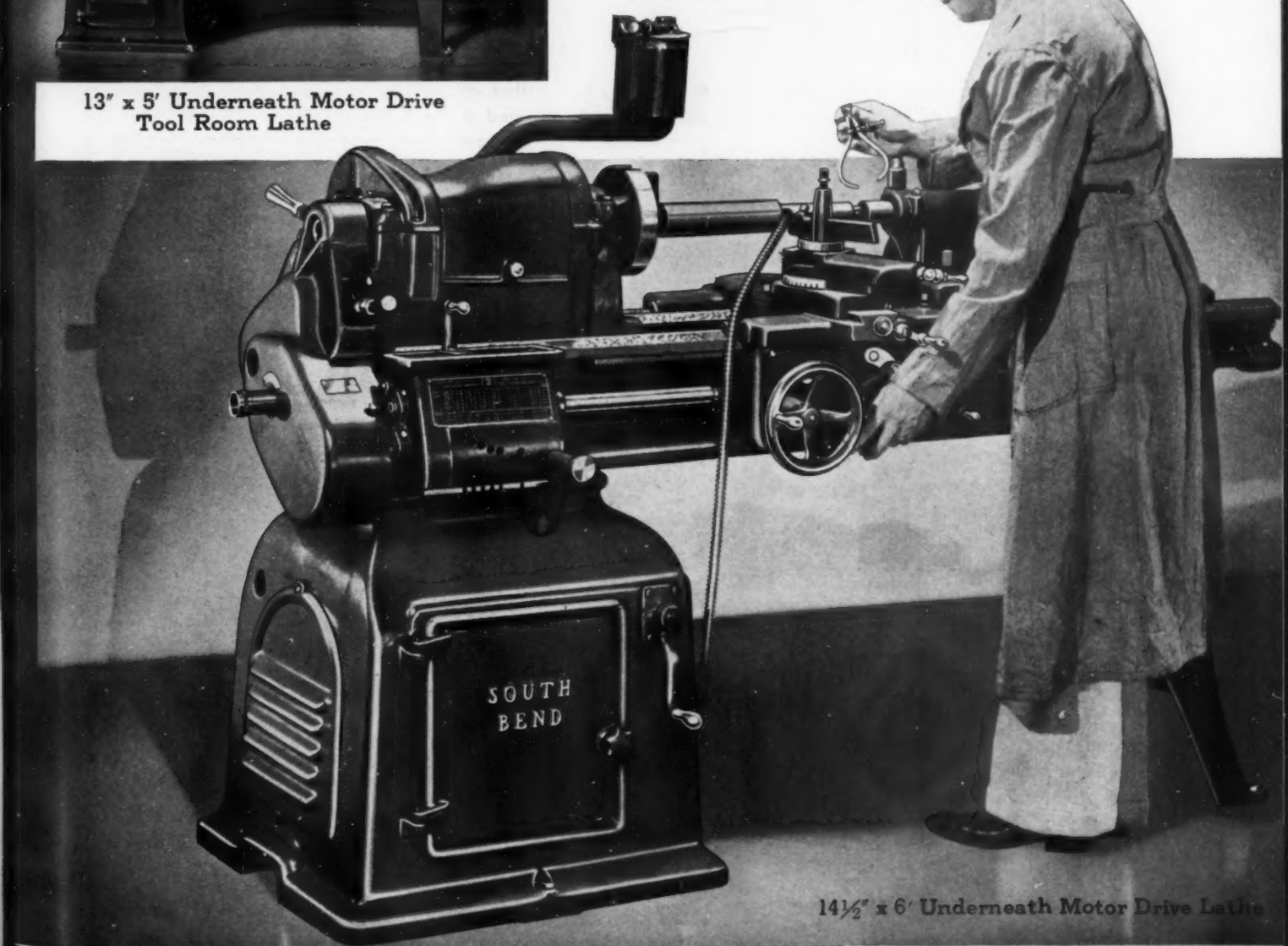
For more than thirty years South Bend Lathes have been giving efficient, dependable service in the tool rooms and production departments of America's leading industries. Modern in every respect, capable of the most exacting precision machine work, they represent the maximum lathe value per dollar of cost.

Manufactured in 9″, 11″, 13″, 14½″ and 16″ swing; 3′ to 12′ bed lengths; Quick Change Gear and Standard Change Gear types; Countershaft and Motor Drive. Write for a copy of General Catalog No. 98.

Immediate Delivery can be made on popular sizes from dealer display stocks in principal cities, a few of which are listed below. Write for name of dealer nearest you.

DEALERS IN PRINCIPAL CITIES

Boston—MacKenzie Mach. Co.
Chicago—C. B. Burns Mach. Co
Cleveland—Reynolds Mach. Co.
Detroit—Lee Machinery Co.
Los Angeles—Eccles & Davies
Milwaukee—W. A. Voell Mach.
Newark—I. R. Edwards Mach.
New York—A. C. Colby Mach
Philadelphia—W. B. Rapp Mach.
Pittsburgh—Tranter Mfg. Co.
Providence—G. T. Reynolds & Son
San Francisco—Moore Mach. Co.



14½″ x 6′ Underneath Motor Drive Lathe

SOUTH BEND LATHE WORKS

Lathe Builders Since 1906

229 EAST MADISON STREET
SOUTH BEND, INDIANA, U.S.A.

TRADE MARK SOUTH BEND ENGINE LATHES

"Stark" New Integral Drive Precision Bench Lathes

incorporate our patented built-in V belt Drive • Compact, Smooth, Powerful • Any split speed in a wide range at the turn of the hand-wheel in front • Lever operates quick-acting Clutch and Brake • Stark time-tried double-taper bearings in Standard Model • Anti-friction bearings in High Speed Model, for manufacturing • Both Models furnished in either ¾" or 1" collet capacity • With all the old Stark accuracy and stamina • Prices comparable to other lathes with SEPARATE, sometimes complicated, Drives • Write for Bulletin J.

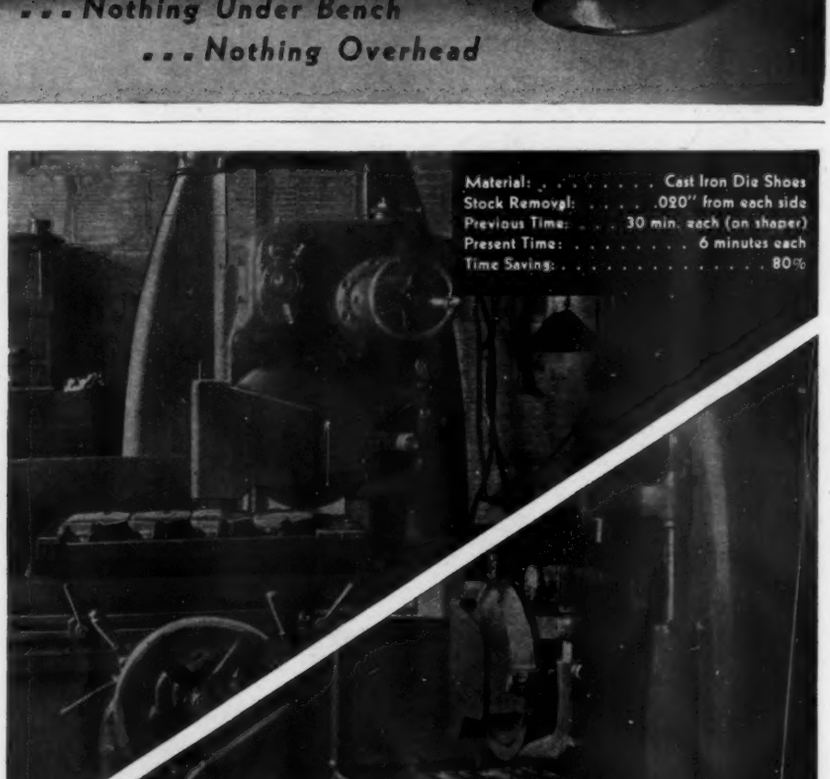
STARK TOOL COMPANY, Waltham, Mass.

• *Originators of the American Bench Lathe* •

MATTISON
HIGH-POWERED
PRECISION SURFACE GRINDER

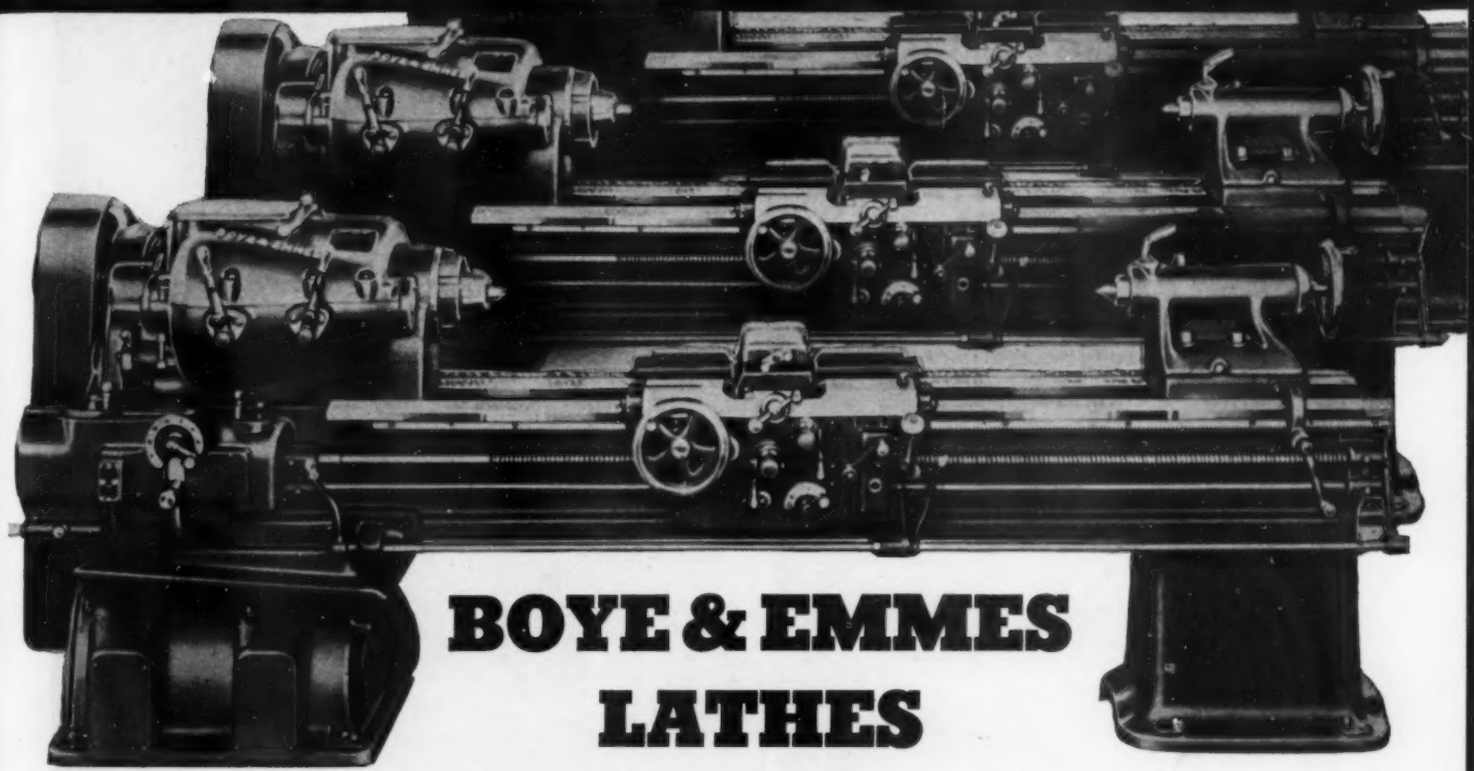
Direct SAVINGS that add to PROFIT

Advantages gained by installing a Mattison Surface Grinder result in lower costs, closer accuracy, speedier production and a fine finish. Operating statistics from many users prove that this machine returns dividends enough to offset the original investment in a short time.


Material: . . . . . Cast Iron Die Shoes
Stock Removal: . . . . .020" from each side
Previous Time: . . . . 30 min. each (on shaper)
Present Time: . . . . . 6 minutes each
Time Saving: 80%
Material: . . . . . H. S. S. Broaches
Stock Removal: . . . . .010" from each side
Previous Time: . . . . . 6 minutes each
Present Time: . . . . . 3 minutes each
Time Saving: 50%

MATTISON MACHINE WORKS—ROCKFORD, ILLINOIS

Lined Up to Help in..... AMERICA'S DEFENSE!



BOYE & EMMES LATHES

● America's *best* defense is a combination of two factors: the establishment of adequate armament reserves . . . plus the equipment necessary for *precision production* of additional war machinery under emergency pressure. A large percentage of this protective preparation will depend—even more than it has in the past—on the speed and accuracy of metal working tools such as *lathes*.

For nearly half a century, the Boye & Emmes Machine Tool Company (formerly Schumaker & Boye) has specialized in the design and construction of *precision lathes*. They have met the toughest competition in *military* as well as *civil* fields. In fact, the Boye & Emmes Line is a veteran of both the Spanish-American and World Wars . . . for they have seen service in American arsenals for *forty-five* years!

That long and varied experience has completely fitted Boye & Emmes to help the metal working industry contribute to America's present need for *strength and security!*

Write today for further details.

The BOYE & EMMES MACHINE TOOL Co.

CINCINNATI OHIO

JUDGE BORE MICROFINISH IN *four* WAYS

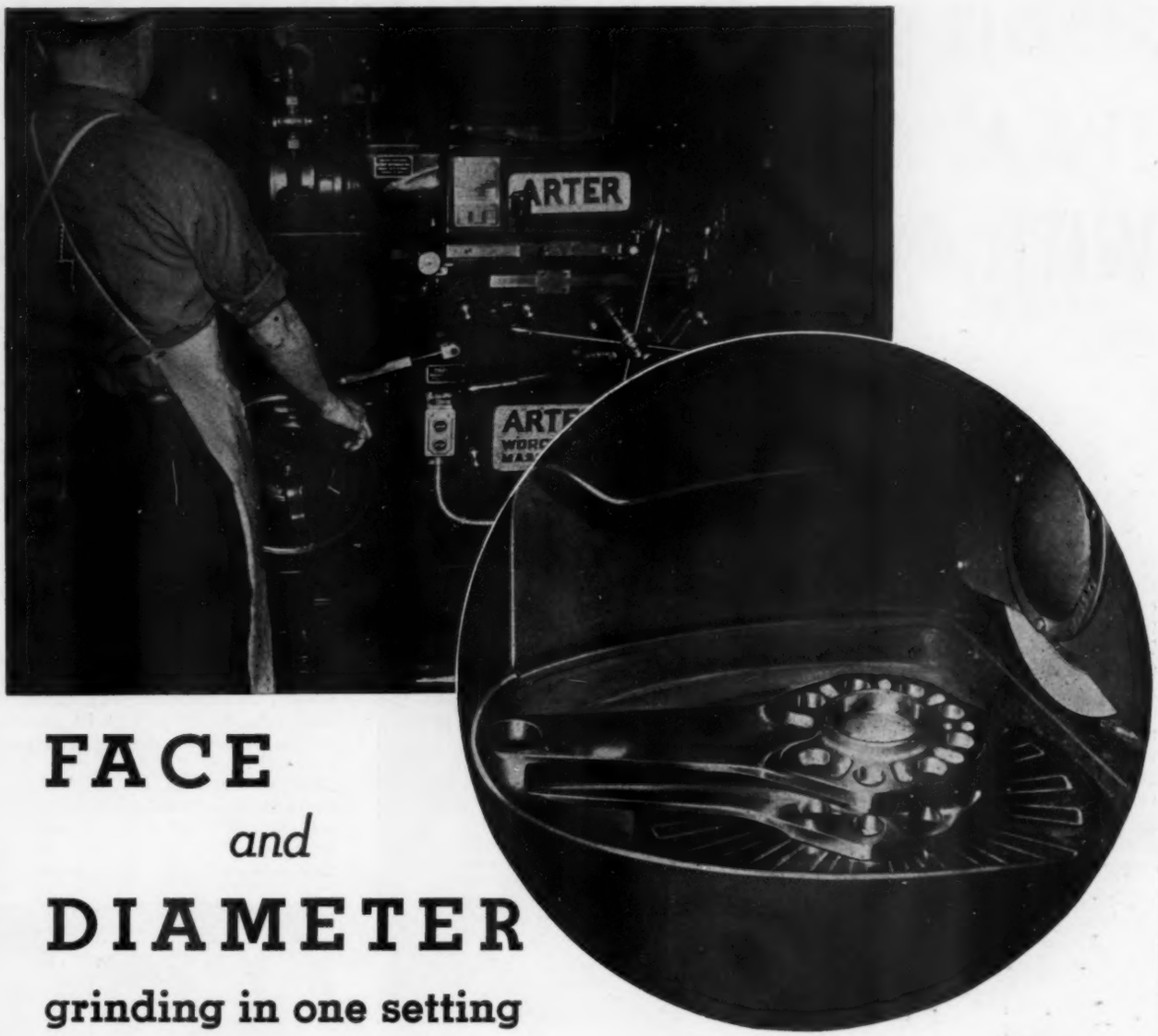
A lustrous metal surface is always impressive to look at, but smoothness, to be effective, must be combined with dimensional accuracy and absence of deformed metal structure.

Honed Microfinish is the one process which controls all these variables and at the same time produces any degree of smoothness desired. In bores, it generates both roundness and straightness, consistently within uniform tolerances, and provides sufficient volume stock removal to eliminate dimensional errors and deformed surface metal throughout the bore.

Write for information pertaining to your product.

SAFETY—Microfinish Honing contributes complete safety of finish machine processing for expensive aircraft and ordnance parts and is also the quickest, lowest cost method.

MICROMATIC HONE CORPORATION
7401 Dubois Street **Detroit, Michigan**



FACE *and* DIAMETER

grinding in one setting

This master connecting rod for a radial aeroplane engine is ground on the flange face, the hub diameter, and the connecting radius at the same setting on a Model A-3-16" Rotary Surface Grinder.

The chuck spindle is mounted, top and bottom, in selected, precision, double-row, preloaded ball bearings. This rigid construction, with a micrometer screw stop to the forward movement of the wheel slide, insures accuracy in diameter grinding.

Arter Rotary Surface Grinders, in various diametrical capacities up to 30," are extremely popular in this aeroplane engine plant. Full advantage is taken of their great vertical capacity and swing.

ARTER GRINDING MACHINE CO.
WORCESTER, MASS., U.S.A.

IT STARTED IN THE AIRCRAFT INDUSTRY WITH CYLINDER STUDS!

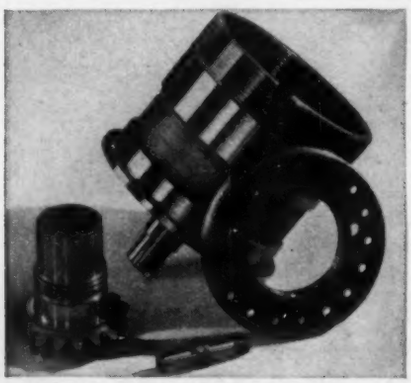
Now grinding is top ranking production method for generating threaded parts

HOW can we put better, stronger threads on our highly stressed cylinder studs? That was the cry of the aircraft industry only a few years ago. They had already reached the absolute limit of accuracy and dependability in generating threaded sections by the old methods.

The answer was thread grinding! With the introduction of accurate and efficient machines in 1935, it became possible for the first time to generate cylinder stud screw threads from the blank by grinding... on a production basis. Previous to this, thread grinding had been an obscure process used only for the correction of screw threads.

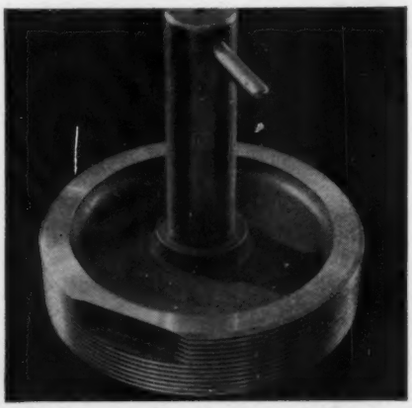
Thread grinding provides the accurate size and perfect finish necessary for the high factor of safety required in aircraft engine parts such as these rocker arm bolts.

The result of grinding the cylinder stud threads was a vast improvement in accuracy and dependability... at a surprisingly low cost. The new method was so sensationally successful that its use was soon extended by aircraft manufacturers to practically all threads on external surfaces, and to internal surfaces where size would permit.



Clutch barrels and related parts are ground to meet requirements for extreme accuracy.

Manufacturers in other fields were not slow to fall in line. They have eagerly adopted thread grinding and made it one of the top ranking production methods for generating threads of all kinds... in a wide variety of materials... for almost every conceivable purpose.



Grinding was used to make this tapered plug gauge for internal pipe threads.

Thread grinding has many advantages

No wonder thread grinding was enthusiastically received. It gives a highly accurate thread section, with a smoother, better finish and appearance. The thread is stronger and more dependable. There is almost a complete absence of checks and cracks. And because the grinding is done after heat treating, the threads are unusually hard and wear resistant.

These advantages are gained with no sacrifice in economy. Production is rapid and the cost low. For a given degree of accuracy, many thread pitches may be produced from the blank in a fraction of the time required to mill or turn the same threads. No special skill or experience is required by the operator.

Any material can be threaded by grinding

Any material, metallic or non-metallic, which can be ground can also be threaded by means of special thread grinding wheels and thread grinding machines. The advantages of the process are particularly outstanding on the threading of corrosion, heat and abrasion resisting alloy steels;

Thread grinding is simple. Accurate results are secured without experienced operators.

and on those materials with abrasive qualities like hard rubber, hard fibre, hard baked carbon, and moulding compounds (especially those containing fillers like mica dust).

Correct grinding wheels necessary for best results

As in all precision grinding, the use of the right wheel is of paramount importance in thread grinding. Even before the appearance on the market of thread grinding machines for production work, Carborundum had discovered and introduced the modern types of specially bonded thread grinding wheels. This availability of suitable wheels had a great deal to do with the immediate success of thread grinding on a production basis.

Adequate stocks of uniform, high-quality Carborundum-made thread grinding wheels are carried at all times, to meet every thread grinding requirement from 2 to 80 threads per inch. And Carborundum's wide

Strong, accurate threads are ground with Aloxite Brand Resinoid and "AA" Aloxite Brand Vitrified Wheels manufactured by The Carborundum Company.

experience in thread grinding is available at once to any manufacturer who is interested in a further investinvestigation of the advantages of this revolutionary process. Inquiries will be welcomed at any office of The Carborundum Company.

CARBORUNDUM
REG. U. S. PAT. OFF.
ABRASIVE PRODUCTS

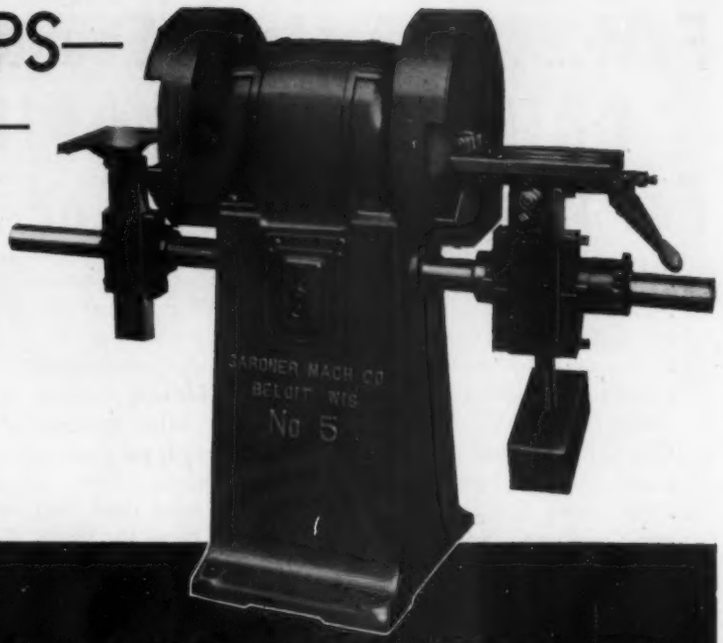
THE CARBORUNDUM COMPANY
REG. U. S. PAT. OFF.

Niagara Falls, N. Y.

Sales Offices and Warehouses in New York, Chicago, Philadelphia, Detroit, Cleveland, Boston, Pittsburgh, Cincinnati, Grand Rapids

Carborundum and Aloxite are registered trade-marks of The Carborundum Company

for SMALL SHOPS—
for the erecting floor—
for light manufacturing ANYWHERE—
the
No. 5-18"
GARDNER
DISC GRINDER!



WILL LOWER YOUR COSTS ON MANY SMALL FLAT SURFACE JOBS!

THIS handy 18" Gardner Grinder is filling a long-felt need for a small, but "husky" tool available at a most moderate investment.

IT IS STURDY—a well-proportioned base, full-size standard work tables, and a ball-bearing mounted spindle carrying two 18" wheels with heavy 1" or 2" thick abrasives.

IT IS POWERFUL—the 3 H.P. special built-in motor provides ample power for all average work. And it operates at 1200 R.P.M.—the CORRECT speed for 18" abrasives.

IT IS FULLY MODERN—heavy welded steel safety hoods and a ball bearing dressing device.

Yet it requires a surprisingly low investment—just the tool for hundreds of smaller shops!

WRITE FOR BULLETIN 202!

EVEN for light manufacturing jobs, heavy-duty 1" or 2" thick Gardner WIRE-LOKT Abrasive Wheels provide modern, economical cutting members. They reduce the maintenance of your Disc Grinder to the very minimum.

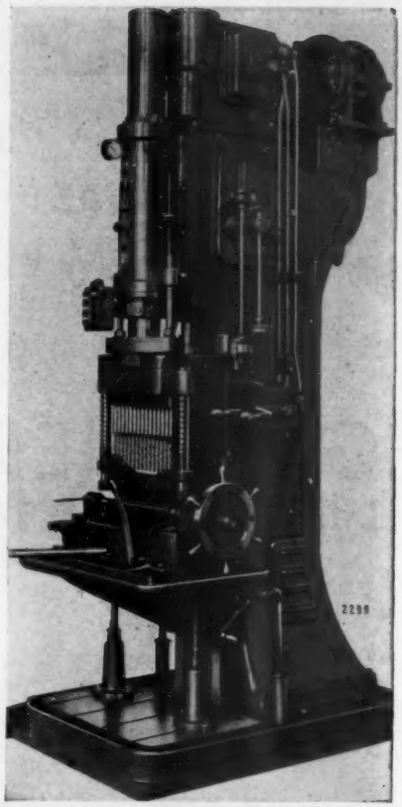
GARDNER MACHINE COMPANY
410 East Gardner Street . . . . . Beloit, Wisconsin, U. S. A.

Fast... Accurate... Economical
DRILLING and HONING
For Army, For Navy, For Peace

Self-Oiling, All-Geared Drilling Machines, Hydrams, and Honing Machines are leaders in commercial high-production manufacturing . . . equally prominent in modern arsenals, navy yards and aircraft factories.

Our Drilling Machines are made in simple single-purpose types; with All-Geared Quick-Change Speeds and Feeds; and in the Hydram type which has hydraulic feed. They are built in Single-spindle, Gang, and High-Production Units. Their range for drilling, boring, tapping, and similar operations is from 3/8″ to about 4″ diameter.

Barnesdrill Honing Machines, Internal and External, are pioneers in the field, thoroughly modern; extremely accurate, efficient, and economical. They are built in many different sizes and types, to hone anything for which a hone can be made even though it require more than 75-foot stroke or exceed 30″ diameter.



Illustrated is one of the many Hydrams (and other machine-tools) that we have developed for government service. It has an especially interesting fixture and multiple spindle head of our own design. Write for details of this, and many other applications of our Drilling Machines and Barnesdrill Honers. Ask for Catalog A.

BARNES DRILL CO. 830 CHESTNUT STREET . . . ROCKFORD, ILLINOIS, U. S. A.

VITRIFIED

Cuts longer between turns

Vitrified Grinding Wheels assure economy in high quantity production fine precision grinding because they cut longer between each wheel truing. Then, too, these long life, strong wheels require less redressing. They can also be depended on to eliminate gumming, glazing and heating.

All these advantages are available regardless of the grinding job, because there is a size, shape and type Vitrified Grinding Wheel for every grinding purpose. The completeness of the Vitrified line makes it possible for any shop to standardize on Vitrified Wheels.

Our engineers will gladly study your grinding operations and point out the savings you can make through the use of Vitrified Wheels.

BORITE—for all kinds and classes of steel grinding.

CARBORITE—for all classes of cast iron, brass, bronze and aluminum grinding.

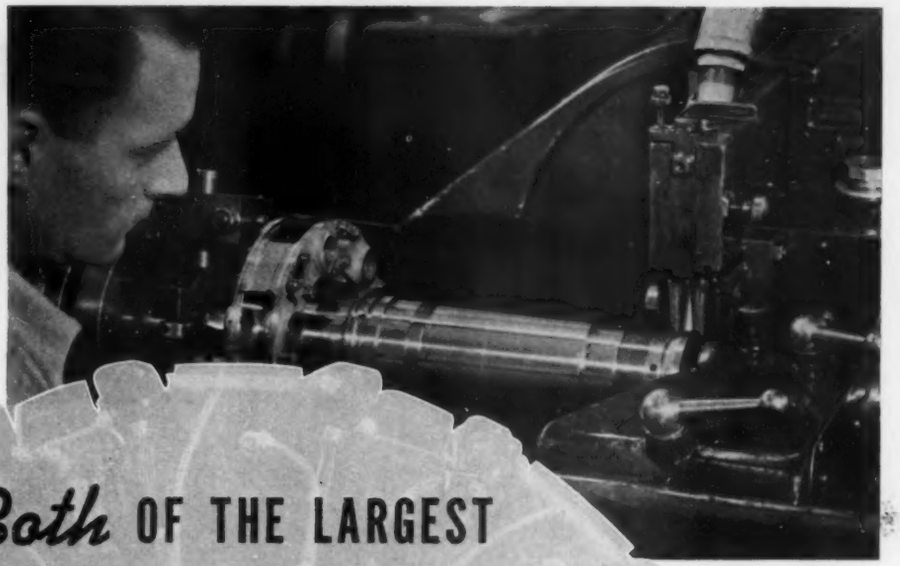
Also, Silicate, Shellac and Resinoid Bonded Wheels.

VITRIFIED

VITRIFIED WHEEL COMPANY
WESTFIELD MASS.

PRATT & WHITNEY

Three sizes of propeller shafts, one of which is shown in the machine at the right, and nine sizes of crankshafts, are ground on this Ex-Cell-O Universal Precision Thread Grinder at Pratt & Whitney. Threaded sections range up to 4" in diameter; the parts range up to 32½" long overall, and up to 16⅝" diameter throw. The threads are 12 pitch, National Standard form, and are ground in the solid, hardened shafts.



Both OF THE LARGEST AIRCRAFT ENGINE BUILDERS USE *Ex-Cell-O*

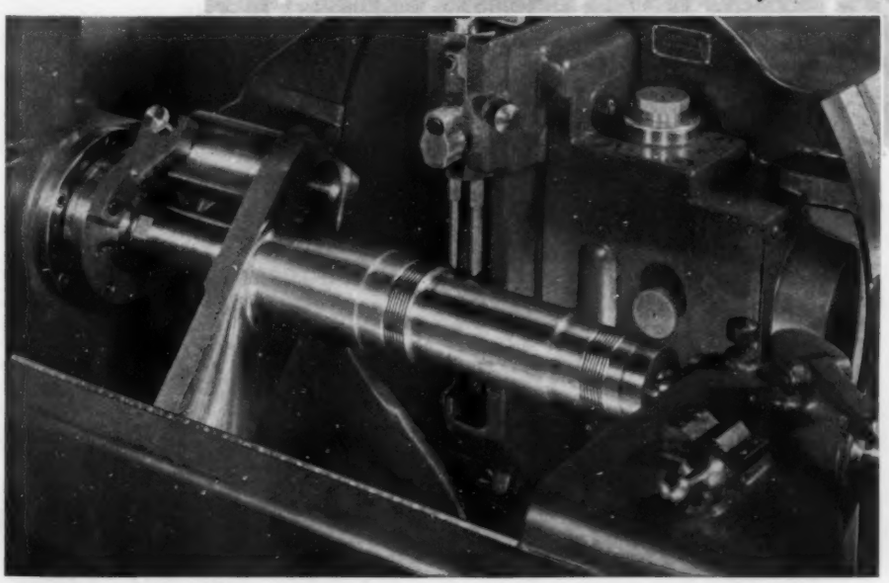
The two largest aircraft engine builders in the United States have installed Ex-Cell-O Universal Precision Thread Grinders for grinding threads in crankshafts and propeller reduction gear shafts.

Ex-Cell-O Machines were chosen for thread grinding, after rough machining and heat treating operations, in order to produce extremely accurate thread form and size, and superior finish—without sacrifice of output or increase in unit cost.

Hydraulic operation and control enable Ex-Cell-O Thread Grinders to handle a wide range of work easily, with fast changeover. Ex-Cell-O Precision Ball Bearings insure wheel spindle accuracy and long life.

EX-CELL-O CORP. • 1200 OAKMAN BLVD. • DETROIT

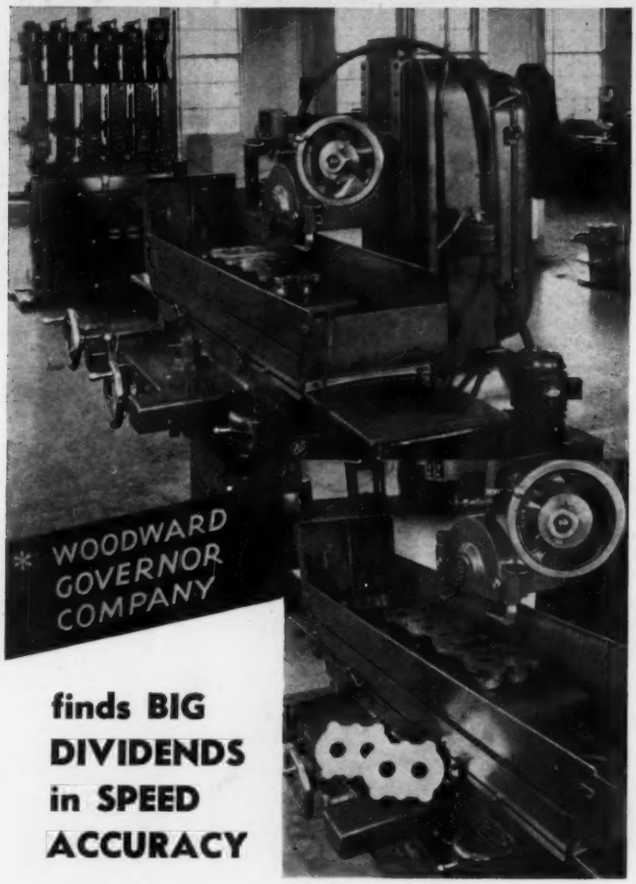
Precision Thread Grinders



WRIGHT AERO

One of the Wright Aero crankshafts is shown being ground on an Ex-Cell-O Thread Grinder. Two threaded sections are ground, both with 12 pitch U. S. Standard form threads. The part is 21 57/64" long overall, and has a 16⅞" diameter throw. Propeller reduction shafts are also ground on the same machine—to closer limits and with better finish than previous methods.

Here's Another Manufacturer* using GRAND RAPIDS Hydraulic Feed SURFACE GRINDERS



finds BIG DIVIDENDS in SPEED ACCURACY

Woodward Governor Company, Rockford, Illinois, manufacturers of governors, finds savings in production through the speed and accuracy of a Grand Rapids Hydraulic Feed Surface Grinder handling precision grinding on parts for governors.

On this machine, pump case bearings of cast iron are being ground at a wheel speed of 1820 R.P.M. and a table feed of 100 ft. per min. Wheel face is 1"; cross feed, .875; tolerance .0002. Production: 12 pieces per hour.

USE THEM IN YOUR SHOP

Available in eight standard sizes and the result of over 25 years' specialization in manufacturing, high-grade surface grinders, Grand Rapids Surface Grinders can be depended on to pay high dividends by assuring the ultimate in precision plus speed in production. They will meet your most exacting needs—at worthwhile savings—and therefore command your closest investigation.

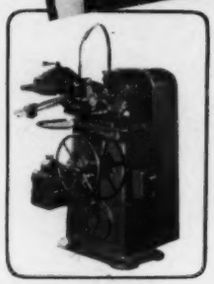
Send for a copy of Bulletin GL-100 featuring Grand Rapids Precision Tool Room Type Surface Grinders
FREE FOR THE ASKING

GALLMEYER & LIVINGSTON CO.
330 STRAIGHT AVE.
GRAND RAPIDS MICHIGAN

Sellers 30W Drill Grinder in use at the Curtiss-Wright Plant

In many plants—

This Operation has reduced drill costs as much as 90 per cent!



A big statement! Yet accurate shop records show that drill pointing on a Sellers Drill Grinder greatly lengthens the life of a drill and increases the number of holes it will produce per grind . . . that these savings alone enable drill costs to be reduced as much as 90 per cent.

And these are only part of the savings that Sellers Drill Grinders make possible—savings that within a single year have amounted to more than six times the cost of the machine.

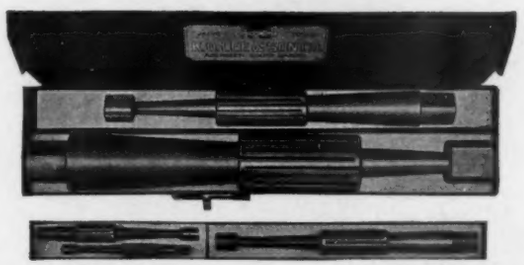
Have a Sellers representative investigate the possible savings in drill grinding operations at *your* plant. Write today.

WILLIAM SELLERS & CO., Inc.
1600 HAMILTON STREET • PHILADELPHIA, PA.

Sellers

KNOCK-OUT

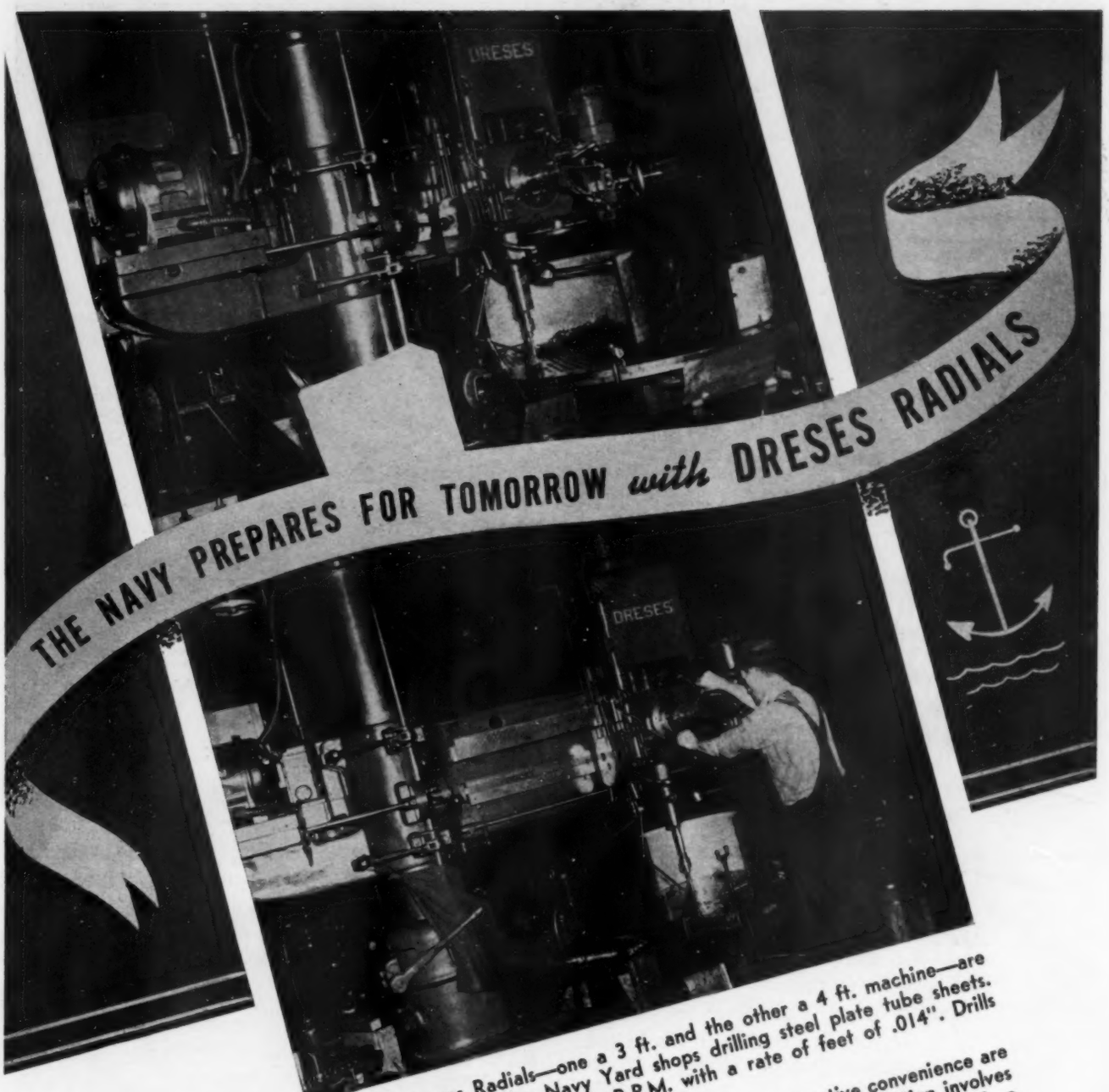
3/8" to 2 1/2" MANDRELS
in One Small Box



A set of Knock-Out expanding mandrels will quickly pay for themselves. In fact you pay for them (in expense making a solid mandrel for each job) whether you buy them or not.

Knock-Out mandrels are made of tool steel, hardened and precision ground, and are accurate within .001". This accuracy is retained indefinitely because the "live" center which is subject to wear, is replaceable. Furthermore, auxiliary centers afford unusually large wearing surfaces, an oil reservoir for constant lubrication and assurance of permanent accuracy. Send for Bulletin No. M38AM.

K.O. LEE & SON COMPANY
Aberdeen, South Dakota

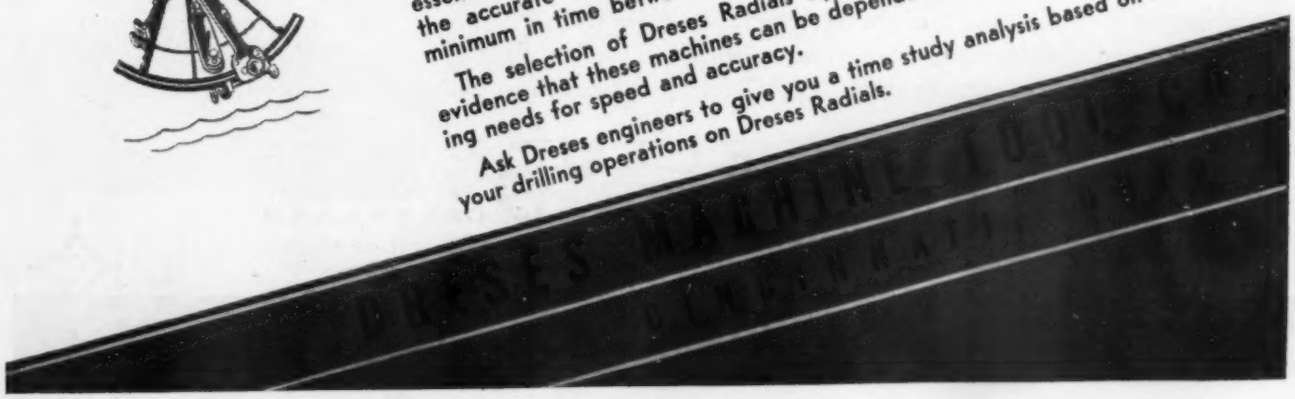


THESE Dreses Radials—one a 3 ft. and the other a 4 ft. machine—are busy in the Brooklyn Navy Yard shops drilling steel plate tube sheets. Each machine operates at 380 R.P.M. with a rate of feet of .014". Drills are 16 mm. high speed steel.

Quick, easy, control and the highest degree of operative convenience are essential in radial drills for this type of work. Low cost production involves the accurate drilling of a vast number of closely spaced holes with a minimum in time between holes.

The selection of Dreses Radials by the Navy for this class of work is evidence that these machines can be depended on to meet the most exacting needs for speed and accuracy.

Ask Dreses engineers to give you a time study analysis based on handling your drilling operations on Dreses Radials.



THE highly accurate methods by which a prominent manufacturer of worms and gears is able to index threads with an error of less than .001" on a 6" diameter applies no less to his practices in drilling holes in the gear blanks and centers shown above.

Gears are of solid bronze, shrunk on and bolted to cast iron centers. All bolt holes are jig-drilled and reamed at assembly for *close-fitting, ground body bolts.*

In high-precision operations such as these, the ability of your drills and reamers to *create values* comes down to these simple things: more holes per grind, more grinds per drill. "Cleveland" Drills demonstrate greater earning power by test in hundreds of tough jobs in competition with other makes.

In competitive tests in bronze and other hard-to-work materials, "Cleveland" Drills produced 33% more holes in one instance; 88% more in another; in still another, over 700% more. The latter is unusual of course, but attested by disinterested outside engineers.

Are *your* drilling costs *low enough?* A "Cleveland" Representative should be able to help you find out, by a study of your materials and present methods. He will gladly visit you for consultation and tests in your own plant.

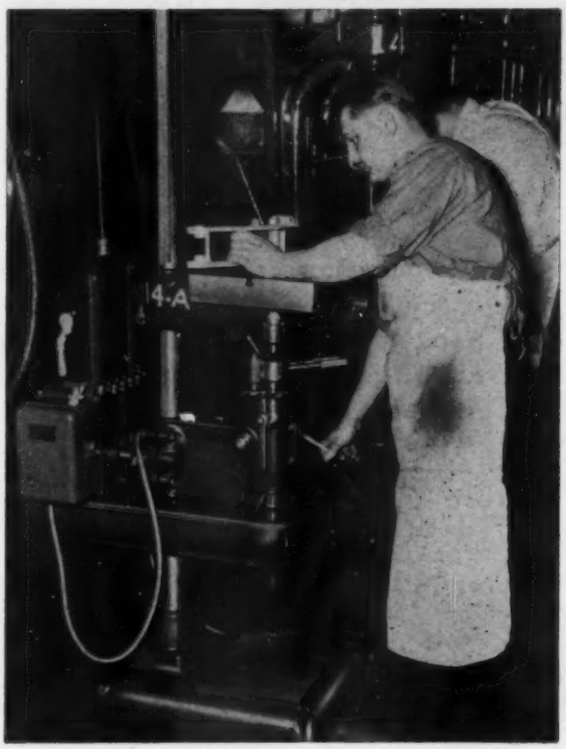
The CLEVELAND TWIST DRILL COMPANY
1242 EAST 49th STREET
CLEVELAND

TRADE MARK REG. U. S. PAT OFF AND FOREIGN COUNTRIES

30 READE ST. NEW YORK · 9 NORTH JEFFERSON ST. CHICAGO · 654 HOWARD ST. SAN FRANCISCO
6515 SECOND BLVD., DETROIT · LONDON - E. P. BARRUS, LTD. - 35-36-37 UPPER THAMES ST., E.C.4

"CLEVELAND" DISTRIBUTORS EVERYWHERE ARE READY TO SERVE YOU

This "Buffalo" Drill increased production 400% at Curtiss-Wright!



Where precision and high production are both important—you'll find Buffalo Tools on the job.

Curtiss-Wright is using Buffalo No. 18 Floor Drills with head inverted and feed pinion reversed for reverse "spot facing." A momentary foot pedal controls magnetic starter.

As a result of this installation, production on this part has been increased 400% over the old method.

Many other Buffalo Drills are in use in this great airplane factory, on a wide variety of jobs.

If you have some simple operation which seems to take too much time, maybe the answer for you, too, is a Buffalo Drill.

The Buffalo No. 0 Bending Roll shown in the lower illustration is another Buffalo Machine which Curtiss-Wright and a number of other airplane manufacturers have found most efficient and economical. The smallest of a complete line of benders, punches, shears, bar-cutters, and billet shears, this machine makes short work of particular jobs—costs practically nothing for maintenance—does not require skilled labor.

Why not bring your drilling and metal shaping problem to Buffalo—for the recommendations of experienced engineers. No charge—no obligation.

BUFFALO FORGE COMPANY

448 Broadway, Buffalo, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

"Buffalo"

DRILLING MACHINES

BENDING ROLLS, IRON WORKERS

Flexibility
FOR VARIED OPERATIONS

Drilling, chamfering, counterboring and reaming operations are combined in machining several different sizes and shapes of plier jaws.

INNUMERABLE miscellaneous operations are daily being done on Footburt drilling, reaming and boring machines. Parts are more accurately machined and work is handled more easily. With indexing tables, either hand operated or automatic, many operations can be combined. Write Footburt about your next drilling problem.

FOOTBURT

THE FOOTE-BURT COMPANY

CLEVELAND, OHIO

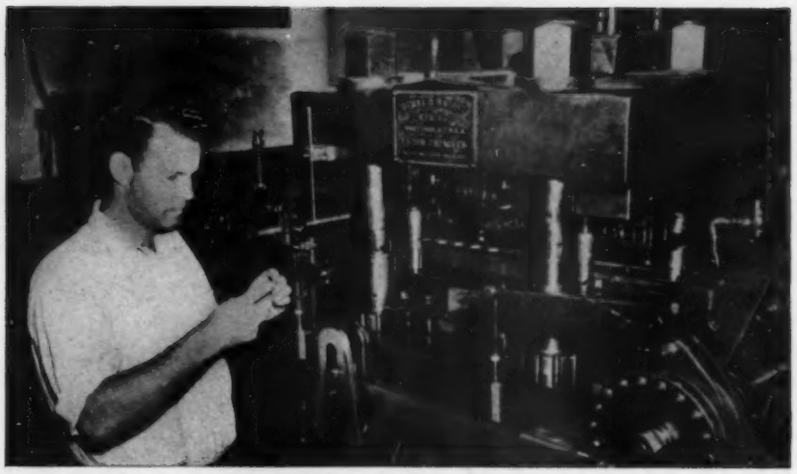
Detroit Office: 4-151 General Motors Bldg. **Chicago Office: 565 Washington Boulevard**

Making cartridge clips

at the

Springfield Armory

on a



HENRY & WRIGHT DIEING MACHINE

REQUEST CATALOG 39

Dieing machines are used in U. S. arsenals and elsewhere for making numerous ordnance items, including cartridge clips, machine gun belt links, mechanical time fuse parts, shell parts, rifle parts, primer insertion and other components. Progressive dies produce one or more completed stampings at each stroke, including piercing, blanking, forming, embossing, extruding, drawing. Dieing machines are made in capacities of 10 tons to 300 tons, and are widely used throughout industry.

HENRY & WRIGHT MFG. CO. Hartford, Conn.

for Results

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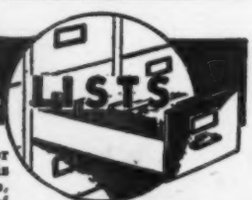

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330 W. 42nd STREET NEW YORK, N. Y.

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"Nichols" HAND MILLERS

SPEEDING UP the PRODUCTION of RIFLE PARTS . . .

Another group of "NICHOLS' Hand Millers in the Spring Arsenal. There are 14 machines in this battery.

Three "NICHOLS" Hand Millers in the Springfield Arsenal

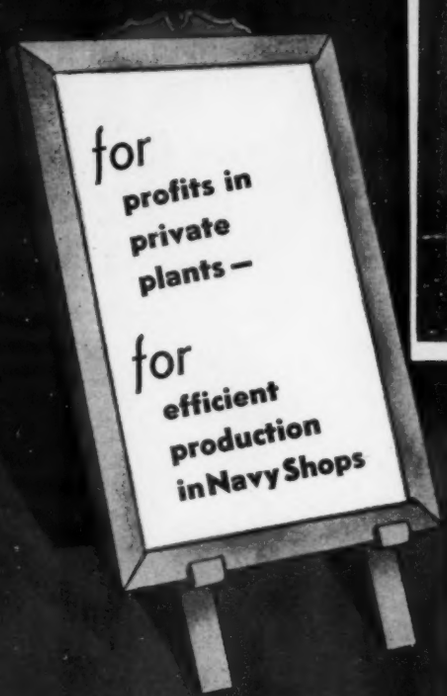
Seventeen "Nichols" Hand Millers are helping speed up the production of rifle parts in the Forming Department of the Springfield Arsenal. The operation performed on each of the three machines in the group consists in milling a 1/16" notch in a rifle barrel at a spindle speed of 100 R.P.M. Production per machine is approximately 60 pieces per hour.

These machines are simple, rugged and modern. They are capable of handling a wide variety of milling operations on small work in any quantities. Accuracy and ease of set up insure highest class work in minimum time.

"NICHOLS" Hand Millers can be depended on to cut costs on the class of work they are designed to handle. It will be to your advantage to investigate these machines and the profit possibilities they offer on your work.

Write for detailed information.

W. H. NICHOLS
WALTHAM, MASS.



A COMPLETE LINE OF CINCINNATI PLANERS AND BORING MILLS . . .

Cincinnati Openside Planers — 30" to 120"
Cincinnati Double Housing Planers — 24" to 120"
Cincinnati Vertical Boring Mills — 4' to 12'
Cincinnati Planer Type Millers — 30" to 120"
Detailed information available on request.

A 60" Cincinnati Hypro Planer, at the Naval Aircraft Factory, Philadelphia, Pa.

This Cincinnati Planer is used in the making and repairing of various aircraft parts, such as landing gear, landplane arresting devices, fuselage parts, wing and tail structures and hulls for flying boats.

Ease of setup, quick adaptability to a wide variety of jobs, flexibility of operation, are outstanding features of Cincinnati Planers. It is this combination of qualities which enables them to turn out, rapidly and efficiently, work of a widely varying nature.

Write for catalogs giving complete operating characteristics of Cincinnati Planers and Boring Mills.

The CINCINNATI PLANER Co.

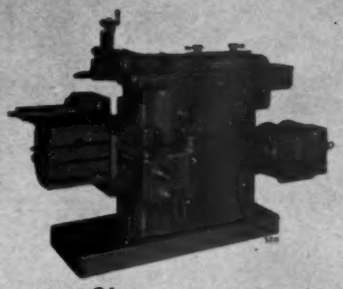
CINCINNATI OHIO, U. S. A.

Reciprocating

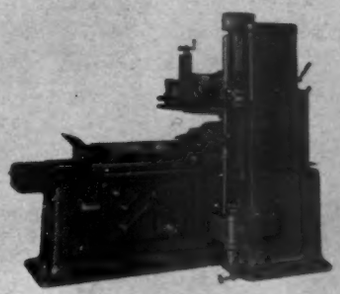
Hy-Draulic

Machine Tools

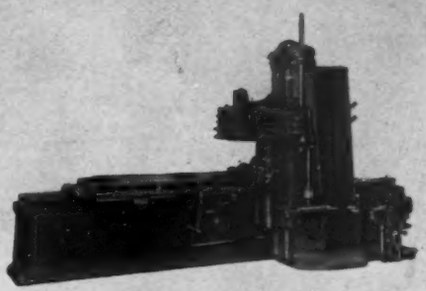
Hy-Draulic Reciprocating Machine Tools, illustrated at right, possess the notable advantages of hydraulic drives and hydraulic feeds viz.: Uniform Cutting Pressure, Stepless Speeds and Feeds, High Return Ratios, Standard Motor Drive directly connected to hydraulic unit. This results in high production, accuracy, fine finish, long tool-life, and over-all economy. Made in sizes which meet all usual requirements of manufacturing, tool work, and maintenance; Hy-Draulic Reciprocating Machine Tools are leaders in commercial work, well and favorably known in government shops everywhere. Complete information on our Hy-Draulic Reciprocating Machine Tools and our Economy Lathes is available for immediate mailing.



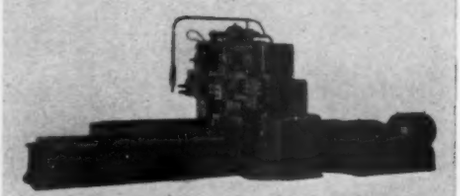
Shapers



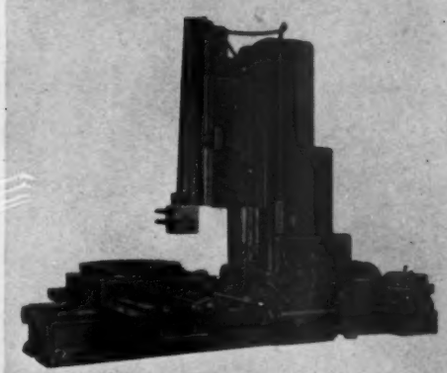
Openside Shapers



Shaper-Planers



Planers



Slotters

Left — A 36" Openside Hy-Draulic Shaper at Springfield Arsenal working on a fixture. Note convenient controls, deep table, protected ways, rugged construction. A fast, versatile machine, excellent companion for shorter-stroke Hy-Draulic Ram-type Shaper appearing at left.

Right — Hy-Draulic Shaper at Rock Island Arsenal, shaping an irregular contour. Send for bulletins, read about advantages of Hy-Draulic Drive and Feeds, easy set-up, convenient control.

ROCKFORD MACHINE TOOL CO.

ROCKFORD, ILLINOIS, U.S.A.

MEET THE DEMAND FOR HIGHER LIGHT LEVELS

Seventy-foot candles on the working plane with the Type H MAZDA Mercury Lamps hung at a 14-ft. level.

. . . with TYPE H MAZDA MERCURY LAMPS

Better light for better sight and better, more uniform production with a minimum of fatigue. That is the modern picture of industrial trends. Men responsible for production are more and more concerned with the levels of illumination. They realize that lighting directly affects the efficiency of all men and machines. » » »

Jobs like the one shown are typical of what is being done. Bear in mind with Type H MAZDA Mercury Lamps you can provide higher light output for a given cost of energy. Enlist the cooperation of the General Electric Engineers. Have them assist you in providing light "engineered to fit the job."

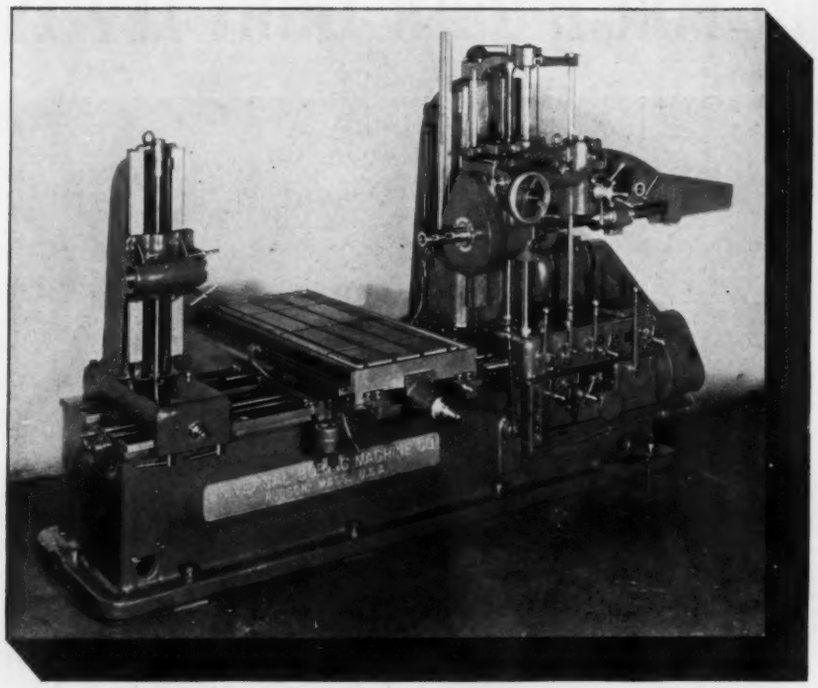
Order your auxiliary devices which were designed especially for this lamp from the General Electric Vapor Lamp Company.

GENERAL ELECTRIC

939H

General Electric Vapor Lamp Co.
831 Adams Street, Hoboken, N. J.

Incandescent Lamp Department
Dept. 165, Nela Park, Cleveland, Ohio



The only **TRIWAY BORING MACHINE BUILT**

Combining

SPEED

POWER

ACCURACY

THIS modern 3-inch spindle Horizontal Boring Mill, featuring the exclusive "UNIVERSAL" TRIWAY BED is a precision built machine which insures outstanding accuracy on work requiring a high degree of productive capacity. It is available in a STANDARD SPEED RANGE from 16 to 650 r.p.m. and a SPECIAL HIGH SPEED RANGE of from 15 to 1200 r.p.m.

The entire range of speeds of the single high speed spindle is available over the 24 inch traverse of the spindle. Rigidity of the spindle provides ability to handle work which could not be handled otherwise.

All units on the "UNIVERSAL" are mounted directly on base, without overhang, thereby insuring the maximum in stability and long life. A deep box type TRIWAY BED provides a foundation of unusual width and stiffness for component parts.

Head assembly is of unit design with spindle carrier cast integral with the main rigid semi-steel body of the head.

Table and saddle assembly is supported by THREE WAYS assuring wide support and ample bearing surface.

Rapid traverse is provided in both directions to *ALL* units and is obtained through a multiple disc rapid traverse clutch which disengages automatically when the operator removes his hand from the control lever.

Write for complete details and specifications.

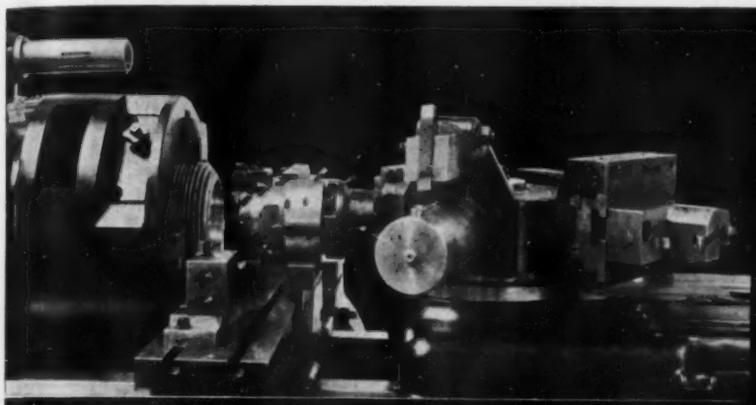
UNIVERSAL BORING MACHINE CO., HUDSON, MASS.

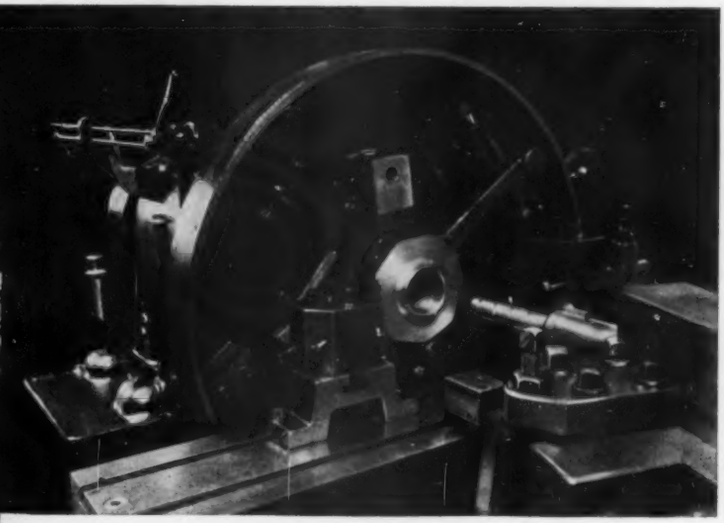
FEATURING

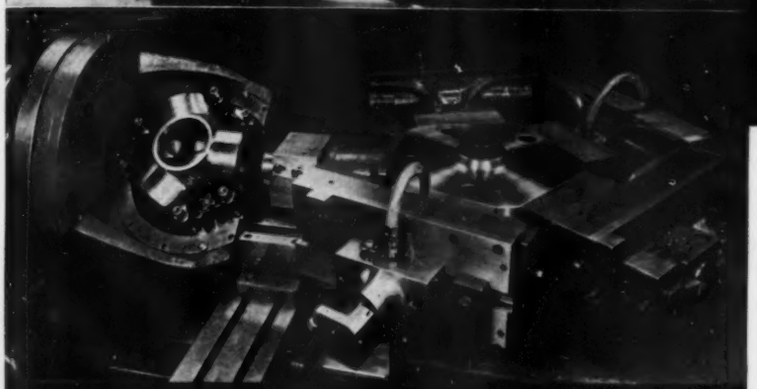
1. **THREE BED WAYS—span 30 inches**
2. **Rod and dial measuring system (extra)**
3. **Table Semi-Box design, heavily ribbed**
4. **Vernier measuring system (extra)**
5. **Motor mounted directly on base**
6. **Safety guards**
7. **Saddle lead screw nut mounted *between* guiding ways**
8. **One shot lubrication for saddle and table assembly**
9. **Knife-edged scrapers**
10. **Hand cross feed for table**
11. **Main clutch control lever**
12. **Motor control buttons**
13. **Centralized right hand control**
14. **Entire machine above floor line**

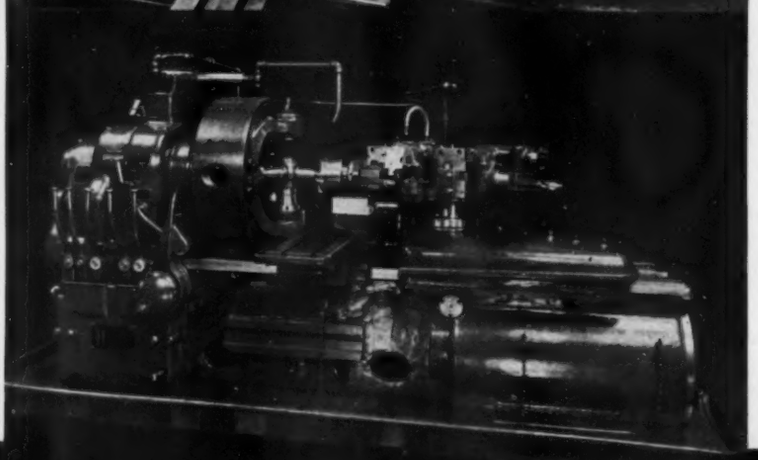
UNIVERSAL HORIZONTAL BORING MACHINE

Aircraft MOVES INTO "TOP-FLIGHT" PRODUCTION









Several batteries of these Potter & Johnston Automatic Chucking Machines are engaged in the manufacture of Pratt & Whitney Aircraft Engines and Hamilton Aircraft Propellers in East Hartford, Conn. Special tooling, developed through the cooperative effort of P. & W. and P. & J. engineers, coupled with standard P. & J. Automatics handle the principal chucking operations on cylinders, cylinder heads, master rods, pistons, cams, reduction gears, propeller barrels, spiders, pistons, cams and domes.

If you are a producer of aircraft parts of any description or work involving similar problems, find out what P. & J. can do for you.

WITH THE AID OF "P & J"

REPRESENTATIVES THROUGHOUT THE WORLD

Potter & Johnston "Automatics"

[POTTER & JOHNSTON MACHINE CO.
PAWTUCKET . . . . . RHODE ISLAND]

BOOST PRODUCTION 54%

with

ETNA SWAGING MACHINE

No. 32 Etna Swaging Machine in Detroit carburetor plant. Operation is to size ball, left, and hold spherical within very close limits. By the old method 426 pieces per hour were produced. The Etna jumped this to 777—a gain of 54.9%!

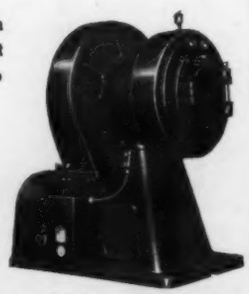
DOES YOUR PRODUCTION REQUIRE

the tapering, sizing or reducing of round solids or tubing of any reasonably ductile material?

If it does you can undoubtedly save time, labor and materials with an Etna Swaging Machine. They save time by eliminating many operations. Money and materials are saved through the reduction, and sometimes complete elimination, of machinery.

Extreme accuracy is assured, too. A prominent automobile manufacturer uses an Etna machine in producing gear-shift control levers with a ball on the end—accurate within 0.002". Either hot or cold work may be handled in these machines, without any additions or changes.

We'll be glad to send you a description of the Etna swaging machine best suited to your particular job, at no obligation of course.



THIS ETNA 156, Right, has a capacity on tubing 1½" in diameter and die 6" long. It can be built in die lengths from 4" to 18".

● ***WRITE NOW FOR MORE DATA***

THE ETNA MACHINE COMPANY

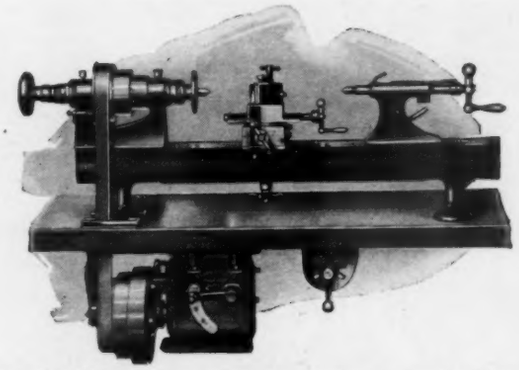
3400 Maplewood Ave. **Toledo, Ohio**

"Stark"

master tools since 1862

NEW SERIES B MOTOR DRIVE UNIT

Silent • Vibrationless
Oil-tight • Reliable



Now furnished with 3 step drive pulley, 9 speeds forward and reverse with single speed commercial motor. No jack-shaft or multiple belts. Fits any bench machine or any bench. Benches, highest grade, furnished if desired. The original and best under-bench drive.

Stark Precision Bench Lathes • 6 Sizes

Lever Chuck Closers and Spring-Bind Heads for fast and extremely accurate manufacturing; Automatic Turret Heads; 3-bearing Heads; 5 Spindle Diamond Drills; Sensitive Upright Drills, Collets, Chucks.

STARK Precision Spiral and Plain Bench Millers

The most accurate of their type. Index Centers are the closest of any in this small size.

"ELECTROBLAST" High Speed Muffle Furnace and Portable Torch $70

Torch Only, $30

High speed heat in 20 minutes. Operates for 7c per hour. No scaling or decarburizing; quickly saves its cost.

Also a larger size furnace, with built-in blower

STARK TOOL CO. Est. 1862 Waltham, Mass.

Originators of the American Bench Lathe

Turret Punches in the Machine Shop at Langley Field, Virginia, are in almost continuous use. Maintaining our "Wings of Defense" calls for operations on punch presses which will provide metal covering for fuselage, wing and airplane tail surfaces; manufacture and repair of installation brackets for navigational and control instruments; parts for fabrication of engine cowling, and oil and fuel tanks.

Wiedemann Turret Punches are quickly adjusted for punching either hard or soft metal. This quick adjustment feature permits exceedingly fast work. The 12-inch Throat model will handle sheets 24 inches wide.

Twelve different sizes of punches are always available in the revolving turret. Capacity is 15,000 lb. pressure, secured with ease due to the type of level mechanism. Simple, inexpensive punches and dies are available for accurate punching of copper, aluminum, duralumin, etc.

The Wiedemann line of hand and power punches is complete for every production need. Models available in Throat depths of 12", 18", 24", 28", and 54"—pressures from 15,000 lb. up to 160,000 lb. and with 12 to 32 stations.

Complete details gladly sent on request.

Wiedemann Punches are "tops" in many fields:—Air Conditioning — Boiler and Tank Mfg.— Food Industries— Electrical — Farm Implements — Laundry Machinery—Radio Manufacturing — Railroads — Shipyards — Tractor Manufacturing — Trailers and Truck Bodies — and many others.

WIEDEMANN MACHINE COMPANY
1801-1831 Sedgley Ave. Philadelphia, Pa.

Measuring a small, machined bar with B&L Contour Measuring Projector, at Springfield Armory.

Accuracy is routine AT SPRINGFIELD

SOME OF THE MANY APPLICATIONS OF THE B&L CONTOUR MEASURING PROJECTOR

Forming tools
Sealing rolls
Cams
Screw threads
Taps
Thread plug gauges
Lead screws
Chasers
Hobs
Thread ring gauges
Dies
Gear teeth
Jigs
Punches
Formed stampings
Knurls

Manufacturing rifles and parts for other small arms calls for unerring accuracy. All arsenals must work to fine tolerances. Springfield, always famous for its rifles, guards its pre-Cival War reputation today with many precision measurements and exacting inspection operations. But checking by human hands and eyes is time-consuming. So a new B&L instrument has been put on the job to simplify the work of inspector, tool designer and toolmaker.

The B&L Contour Measuring Projector makes a simple routine operation out of checking contour measurements. It eliminates tedious, elaborate set-ups and exacting calculations. Its accuracy requires no "check and double check." Use of this Projector is quickly learned and its operation simple.

Whether the object be a rifle part such as produced by Springfield Armory or parts for other use, inspection and measurement can be simplified by optical projection with this new B&L instrument.

Many B&L products for the metal working trade are described in the B&L Catalog D22 and D27; sent on request. Write to Bausch & Lomb Optical Co., 619 St. Paul St., Rochester, N. Y.

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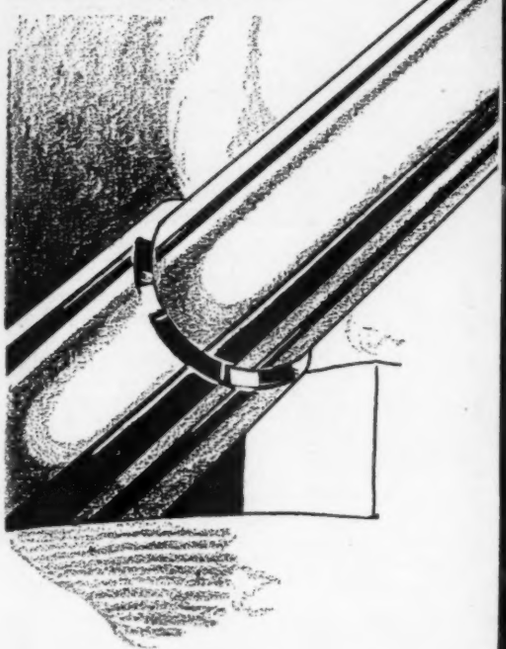
FOR YOUR EYES, INSIST ON BAUSCH & LOMB EYEWEAR, MADE FROM BAUSCH & LOMB GLASS TO BAUSCH & LOMB HIGH STANDARDS OF PRECISION . . . . . .

Direct hits for years–
FERRACUTE
cartridge-making presses

Ferracute Machine Company has specialized for years in cartridge-making presses for both small arms and artillery ammunition. Ferracute presses are as efficiently economical in this as in thousands of industrial applications.



Since its development, the 75 millimeter gun has been the finest and most accurate field piece of the armies of the world. But no gun is any better than its projectiles, and no projectile is any better than its propelling charge.

Here a Ferracute 6-station press, at the Frankford Arsenal, is tapering the 75 m/m cases. The press forces the drawn shell into a die to produce the necking and tapering operations which facilitate the ease in ejecting the fired case. The operator need only feed the machine and remove the finished case. The die is so designed that the finished case is ejected automatically.

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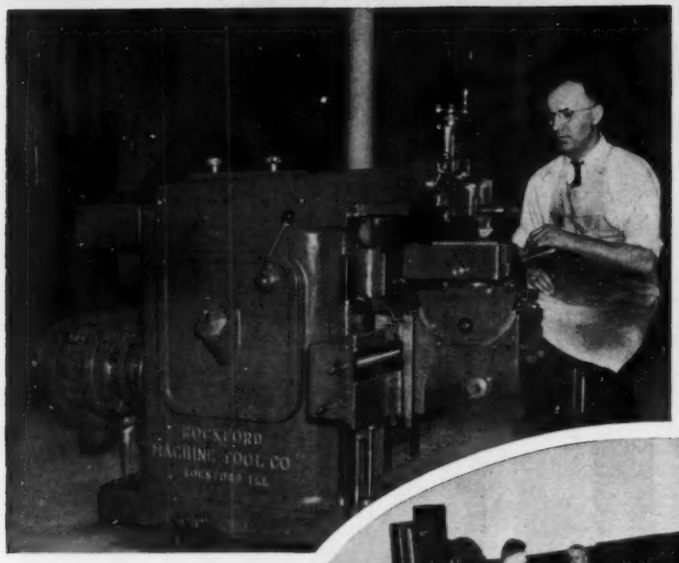
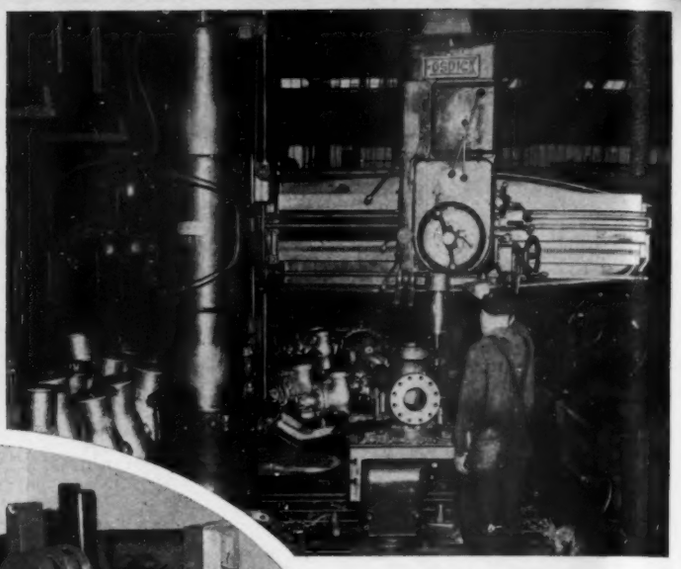
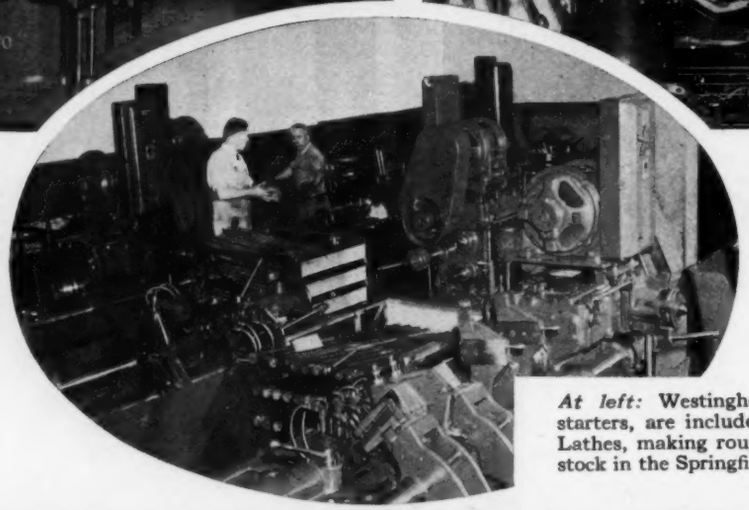
THEY'RE IN THE ARMY
doing machine jobs the



Above: This 12" Rockford Hydraulic Shaper in the tool room of the Springfield Armory is amply powered for heavy cuts, with a Westinghouse flange-mounted gearmotor. Equipped with Westinghouse control.



Above: Fosdick Economax 8' Radial Drill, one of two such machines in the Brooklyn Navy Yard shop, equipped with Westinghouse motors and control. This powerful machine can be depended upon to handle tough drilling jobs easily, with the ample capacity in the motor to take care of the load.



At left: Westinghouse motors and "De-ion" Linestarters, are included on the ten 12" Fay Automatic Lathes, making rough and finished cuts on rifle barrel stock in the Springfield Armory.

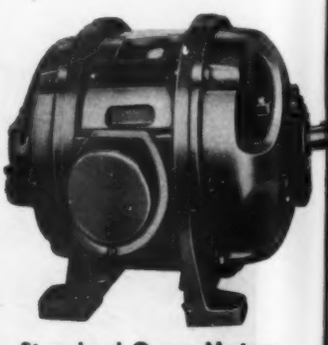
WESTINGHOUSE EQUIPMENT "STANDS UP AND TAKES IT"

Toughness and durability are built into every part of Westinghouse motor and control equipment. You'll save money in the long run by specifying Westinghouse drives for every industrial use. And . . . the diversity of the Westinghouse line allows you to select the right drive for the job to be done.

Combination Linestarters

◂ One packaged unit does 4 jobs
Westinghouse Combination Linestarters cost less to install, and combine four jobs in one unit: magnetic motor starter, manual disconnect switch, motor overload protection and Nofuze circuit protection. Save wiring, conduit, labor, get better results, with Westinghouse Combination Linestarters.

Extra features at no extra cost ▸
Westinghouse standard AC motors provide the extra mechanical strength of rigid one-piece frames, and the extra electrical strength of Tuffernell insulation. Bearings, either ball or sleeve, free from lubrication grief.



Standard Open Motors

Westinghouse

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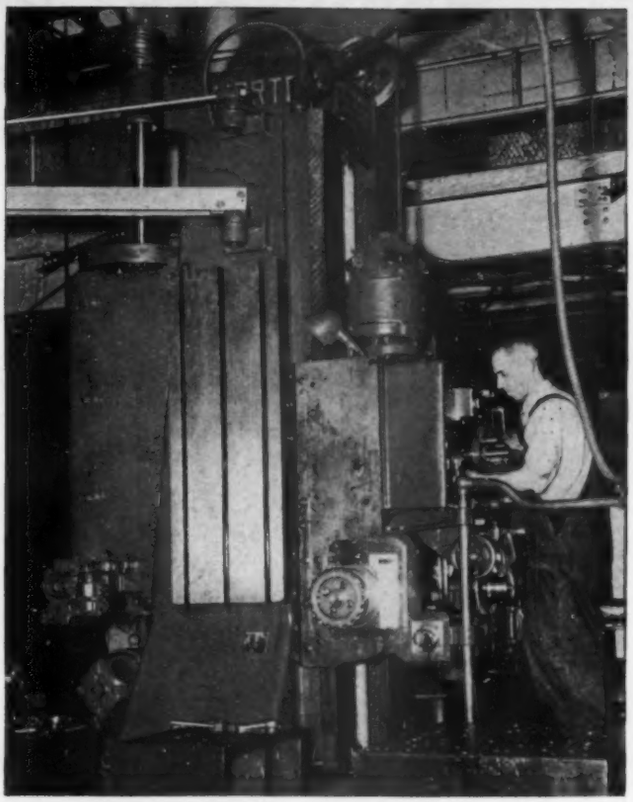
WESTINGHOUSE ELECTRIC

AND NAVY *NOW*....
modern electrical way

Modernizing with Westinghouse motors and control helps armories, navy yards and mobilized industry maintain high production schedules, reduce outage time, and save money and maintenance.

Whether you are concerned with national defense programs, or engaged in industrial manufacturing, you are interested in cutting costs and improving production. Your local Westinghouse representative will help you do it electrically. Call him. Or, if you prefer, write Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. Address Dept. 7-N.



Above: Ample power and convenient operation assured at all times on this new 60" Morton Traveling Head Draw Shaper in the Brooklyn Navy Yard — it is equipped with Westinghouse motor and control.

J-90215

Safety Switches

◄ **Extras that cut operating costs:** Westinghouse Safety Switches give you more for your money — in better protection. Diamond pointed jaw and extended blade keep contact areas clean, free from beading. One-piece copper parts make fewer connecting points.

High speed motor efficiency for low speed machines: ► You get the exact horsepower needed at the required rpm of the driven machine, all in one space-saving motor. Simplifies installation, eliminates maintenance of belts, pulleys, sprockets and chains. Delivers 96% to 98% of the motor's efficiency.

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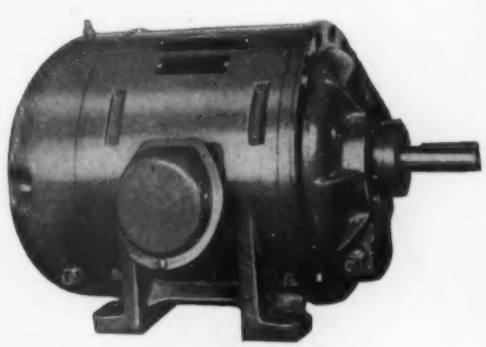
Gearmotors



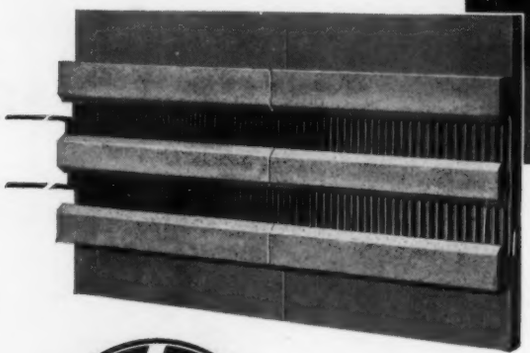
Totally Enclosed Motors

Motors and Control

At SPRINGFIELD ARMORY... *for* small rifle parts

This FR-207 Hoskins Electric Furnace is typical of many Hoskins units in government service handling precision heat treating operations.

Wherever accuracy and close control are important considerations, electric heat commands consideration. If precision heat treatment counts with you, then you'll be interested in the useful information found in our *new* Catalog-57T.



The FR furnace is equipped on all four sides with Chromel ribbon elements installed as shown. Renewals, seldom needed, are easily made.

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Specify Chromel for your Heating Elements

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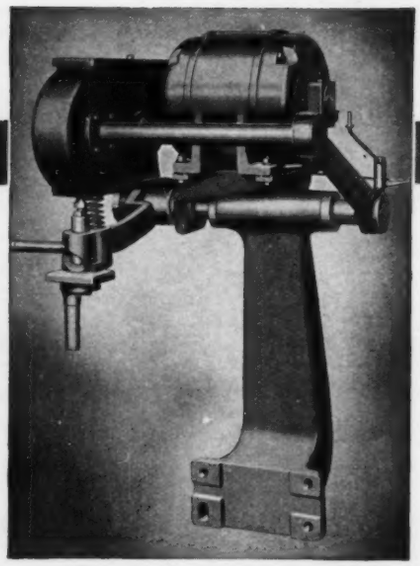

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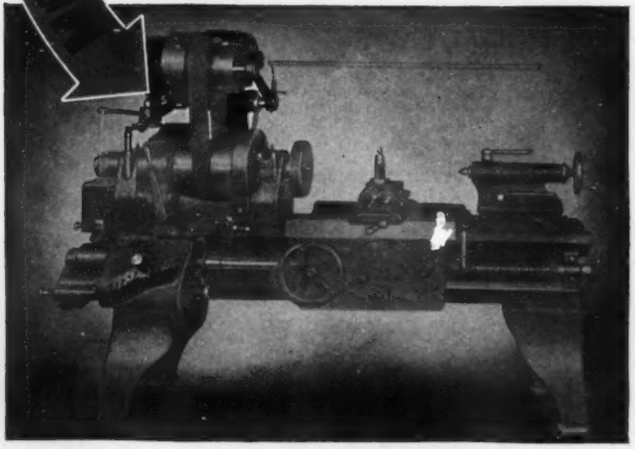

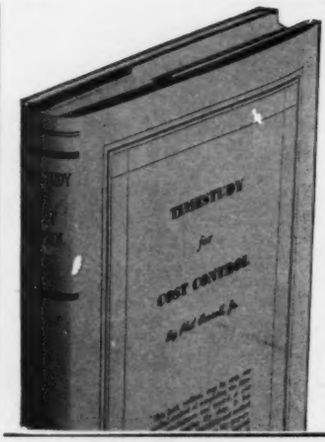

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evident in tool stockroom at
SPRINGFIELD ARSENAL

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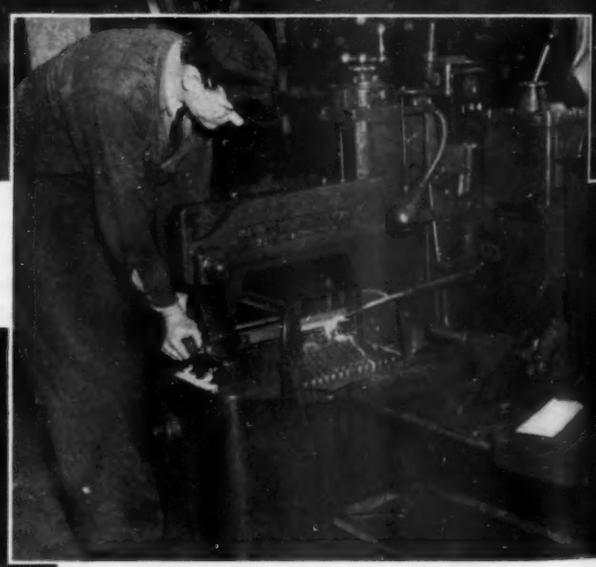
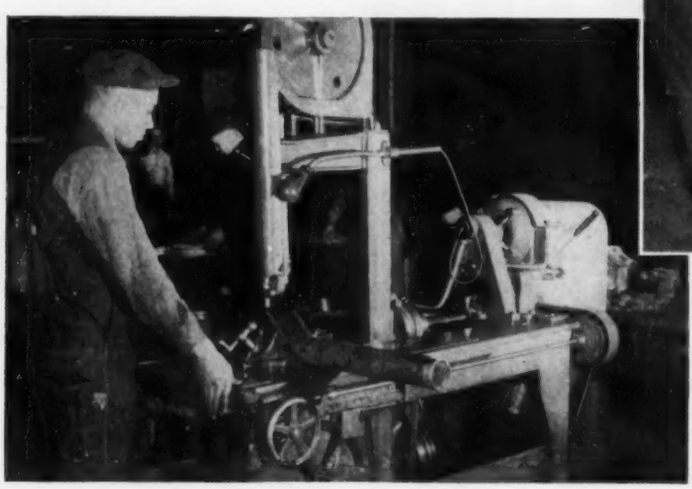
Two MARVEL Metal Band Saws—Model No. 8—sawing stock at the Brooklyn Navy Yard.





MARVEL Model No. 6 Heavy-Duty High-Speed Saw at Springfield Armory. Three saws of this model take care of sawing all rifle barrels.

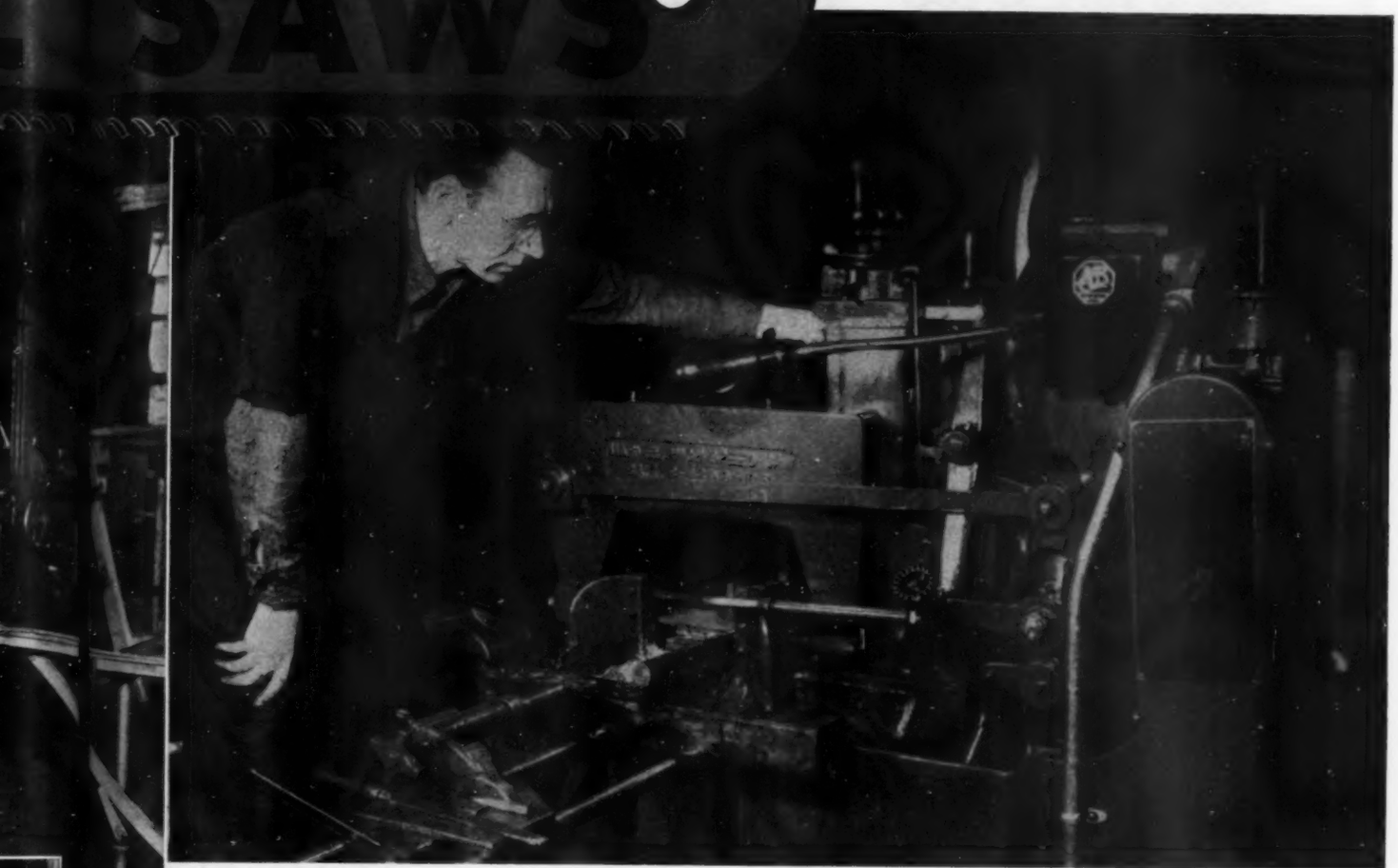
●

Write for Bulletins covering Small Hack Saws, Light and Heavy Duty High Speed Large Capacity Hack Sawing Machines, Metal-Cutting Band Saw or Giant Hydraulic Hack Saws or Automatic Production Saws; or have our local MARVEL Metal Cutting Engineer call to make a study and recommendations to modernize your sawing equipment.

NEED FOR SPEED

SAWS

MARVEL High Speed Hack Sawing Machine, in operation at the Boston Navy Yard.



IN immediately strengthening our forces afloat and ashore—efficiently and yet at top speed, the Marvel System of Metal Sawing is widely used.

For instance, at Springfield Armory rifle barrels are cut on several MARVEL Automatic Production Hack Saws. Equipped with unbreakable MARVEL High Speed Edge Blades. These composite blades permit high speed operation and reduce machine hour loss for blade changes. In the Brooklyn and Boston Navy Yards MARVEL Band and Hack Saws cut pipe stock, and bar stock for innumerable parts needed for naval vessel construction and manufacture of ordnance.

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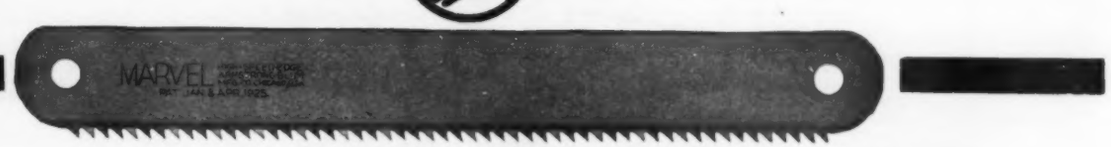
No matter what your present sawing equipment, unbreakable MARVEL High-Speed-Edge Blades with a genuine 18% Tungsten cutting edge welded to a tough alloy steel body permit higher speeds, greater blade tensions and heavier feed pressures.

MARVEL



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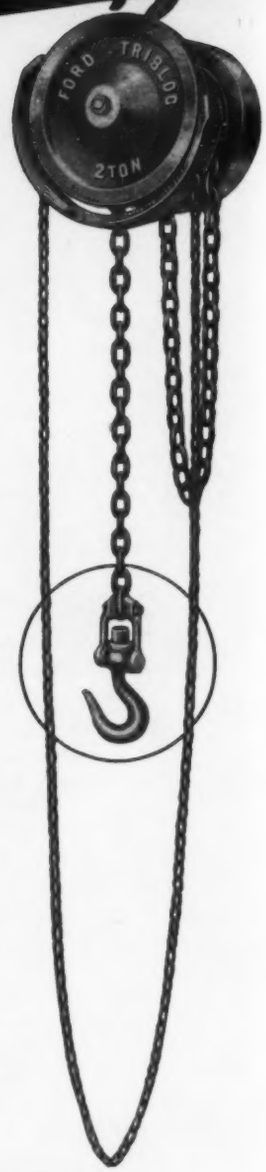

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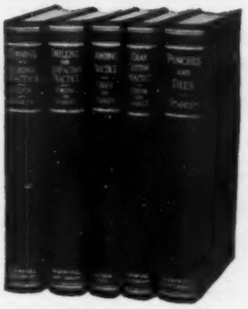

5 volumes, 2014 pages, 1853 illustrations
Many charts and tables

THESE books answer your questions on methods and machines—tell what you need to know about the operation of machines of all types and sizes for the whole range of metal cutting, forming, and finishing operations—show by text, diagram, and illustration the essential points of setting up work, adjusting machines, selecting feeds and speeds, determining pressures, handling materials, devising short-cuts, etc. With these books at hand for quick reference, no job is too hard or unusual, and the routine jobs may be improved, with savings in time and trouble and reduced wastage.

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—*In this, the* SMALLEST *of the famous*

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Model A—8 x 12 x 18—features a heavy vibrationless base, hydraulic power units, centralized controls, large anti-friction bearings, heat treated alloy steel spindle, operator safeguards, *and speedy economical precision grinding!* For cool cutting, easily maintained accuracy, and high production in surface grinding, investigate Thompson! Literature upon request—no obligation.

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He must be first-class mechanic with engineering training.

He should have successful record of accomplishment either as superintendent, assistant superintendent or production manager where high grade machines have been built at proper costs.

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In first letter please give age, references and such additional information, including record of experience, etc., as will assist in early decision.

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(*See also "Selling Opportunity Wanted"*)

CAPABLE MANAGER AVAILABLE. Manager or Superintendent. Good record as to executive, organizing, engineering and inventive ability. Well trained and experienced in modern, efficient and low cost plant operation. An inherent mechanic with the inventive imagination necessary to devise tools and methods for reduction of costs. Thirty-eight years old, with family, good health, good personality, good recommendation from ten year service, good references. Location immaterial. PW-579, American Machinist, 330 W. 42nd St., New York, N. Y.

MECHANICAL ENGINEER (Practical) A.S.M.E. Age 34; with well-rounded experience including: forging, welding, foundry, tinwork, machine-shop, carpentry and pattern-making. Also has a good deal of experience in industrial dust-control. Nine years as Mechanical Engineer and Draftsman. Understands structural and electrical drafting. Proven ability. Capable of holding responsible position. Now and for past three years Mechanical Engineer for a large mining company. Well versed in all phases of Business Administration, and a student of Psychology. Prefer permanent supervisional position with a future limited only by individual effort. All offers invited. Available at once. PW-586, American Machinist, 520 N. Michigan Ave., Chicago, Ill.

POSITIONS WANTED

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2—1500# Chambersburg Steam
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No. 93A Toledo, tie-rod frame, 37" between housings
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Industrial Plants Corporation

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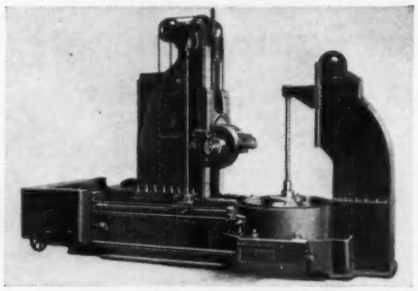

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Diameter can be cut (with supports) —inches	30	Driving pulley—inches	20x5½
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Face capacity—inches	30	Height of machine—inches	132
Cutter arbor diameter—inches	1½	Net weight in pounds	31500
Minimum centers work and cutter arbor—in.	4½	Domestic shipping weight in pounds	31500
Work mandrel diameter—inches	2½	Boxed weight in pounds	35100
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		Cubical contents in cu. ft...2 boxes	435 / 266

Constant speed—10-15 H.P. motor with speed about 1200 R.P.M. recommended.

SPECIFICATIONS

84" x 84" x 18' Detrick & Harvey Convertible Open Side Planer

CAPACITY: 85" under Cross Rail by 85" between housings. Will plane 96" wide on a straight surface by angling left hand head. Equipped with two heads on cross rail and side head; also equipped with additional housing with side head so that machine can be used as a four head double housing planer.

TABLE: 70" wide x 11⅞" deep. 20' overall—18' stroke; three 1⅛" T-slots; also T bolt holes, 10¼" width of table rack. 1 flat and 1 V way—width across flat way 12" —width across V way 8½".

CROSS RAIL: Vertical portion, length, 131" —horizontal has 20" face.

HEADS: Cross Rail Heads have automatic power and hand feeds in all directions. Tool slides have 19" vertical movement.

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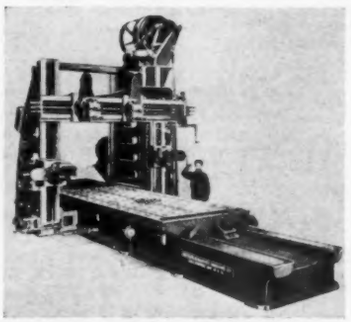

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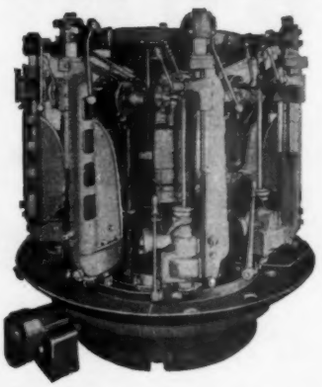

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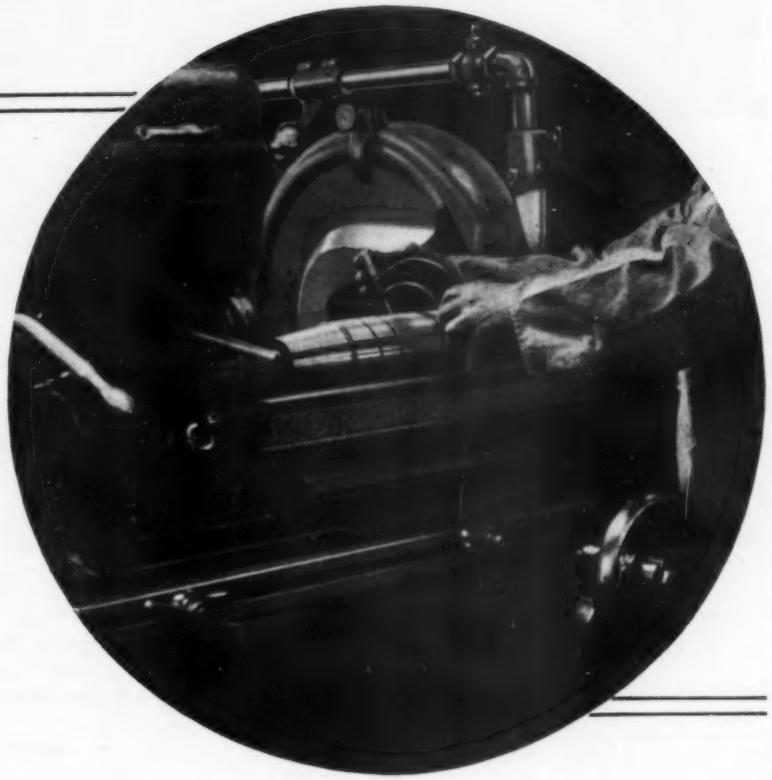
NORTON GRINDERS



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Substantial saving in prices makes these machines real bargains.

PRECISION

True alignment of spindle—Wheel slide — and table together with accurate fitting of component parts insures precision limits of accuracy.

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Elimination of all gears in work head—results in extremely fine finish.

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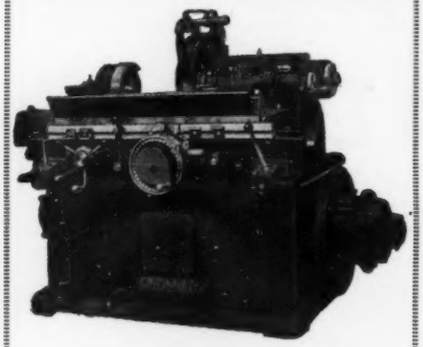

CYLINDRICAL

Cincinnati Saddle Type 8"x18", 8"x36"
Brown & Sharpe #10, #12, #14, #30A
Cincinnati Plunge Cut 12"x18"
Landis 6"x18", 6"x30", 10"x24", 10"x36", 10"x72", 12"x36", 12"x52", 12"x72"
Landis Hyd. 6"x20", 6"x30", 8"x30", 10"x36"
Norton 6"x32", 10"x18", and 10"x36" Type BA, 10"x50", 10"x72", 14"x36", 14"x72"
Arter Auto. Cylindrical #132

INTERNAL

Bryant Hole #3, #12, #18
Bryant Hole & Face #12A
Heald #50, #60, #65, #70, #75, #85
Heald #72 "Size-Matic"
Heald #72A3 "Gage-Matic"
Greenfield "Hydroil" #12, #52
Giddings & Lewis "Teromatic" #11
Rivett #103

CENTERLESS

Cincinnati #2, and #3

DISC

Gardner Opposed Hyd. #123 (16") and #84 (16")
Gardner Prod. Opposed #84A (22")
Gardner Opposed #14 (16")
Besly Opposed #6 (20") #26 (18")
Gardner Horiz. #24 (53")
Gardner Single End #50 (30")
Gardner D. E. #2 (18")), #3CB (18") #4 (23"), #6 (26"), #7½ (30"), #27 (22")
Besly D. E. #41 (20"), 18"
Hisey-Wolf D. E. #8DA (20")

UNIVERSAL

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Cincinnati 16"x48", #2 (12"x36")
Thompson 10"x36"

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Hanchett Rot. #72 Type C (3 heads)
Pratt & Whitney Rot. 8"
Blanchard Vert. #16, #16A
Pratt & Whitney Vert. 14", 14" Mod. B
Abrasive #3, #5, #33
Badger #8
Brown & Sharpe #2
Diamond 84", #4, Type F
Gardner #1, #96-30" Hyd.
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Reid Hyd. #4
Wilmarth & Morman #78
Bridgeport Knife & Face #180

This is a listing of GRINDERS in our Chicago Stock. Many other machine tools in LATHES, MILLS, DRILLS, SHAPERS, PLANERS, CHUCKERS, SCREW MACHINES, GEAR MACHINES, PRODUCTION TYPES, STRUCTURAL, ETC.

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#78 Wilmarth & Morman Surface Grinder M.D.
#3 Abrasive Surface Grinder
#33 Abrasive Surface Grinder M.D.
#2 Cincinnati Centerless Grinder M.D.
14x50 Norton Cylindrical Grinder

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3—#21 Bliss O.B.I. Punch Presses
4—#20 Bliss O.B.I. Punch Presses
2—#19 Bliss O.B.I. Punch Presses
2—#18 Bliss O.B.I. Punch Presses
1—#306 Bliss S.S. Geared Press 6" Shaft 6" Stroke
1—#50 Toledo Arch Press
1—#79½ Bliss S.S. Geared Press 10" Shaft, 18" Stroke, shut height 30"
1—300 Ton Niles Bement & Pond Wheel Press, M.D.

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1—10'x10 Ga. Dries Krump Box and Pan Brake M.D.

LATHES (TURRETT)

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LATHES (SCREW LATHING)

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1—LeBlond 24"x12' Bed. Cone
1—Hendey 16"x6' Tie Bar.

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#3 Cincinnati Vertical Mill arr. M.D.
#2 Van Norman Duplex Milling Machine
#½ Van Norman Duplex Milling Machine

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2—#0 Brown & Sharpe Automatics
6—#00 Brown & Sharpe Automatics

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1—18" Gould & Eberhard Shaper Single Pulley Drive
1—20" Gould & Eberhard Shaper Single Pulley Drive
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Landis Crankshaft Grinders 16"x48", self contained countershaft motor drive
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No. 4 Le Blond Heavy Duty Plain Miller S.P.D.
No. 4-B Becker Vertical Miller M.D.
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Drill, Radial, 6' Reed-Prentice G.B., SPD.
Hammer, Power, 100 lb. Little Giant.
Keyseater, Morton, 2¼"x24", S.P.D.
Lathe, 36"x16' N-B-P. DC Motor.
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Miller, #3 Cin. High Power, M.D.
Miller, #3 Kempsmith Univ., cone.
Pipe Mach., 18" Standard, M.D.
Pipe Mach., 6" Landis G.B., M.D.
Pipe Mach., 4" Oster, M.D.
Pipe & Nipple Mach., 2" Landis, M.D.
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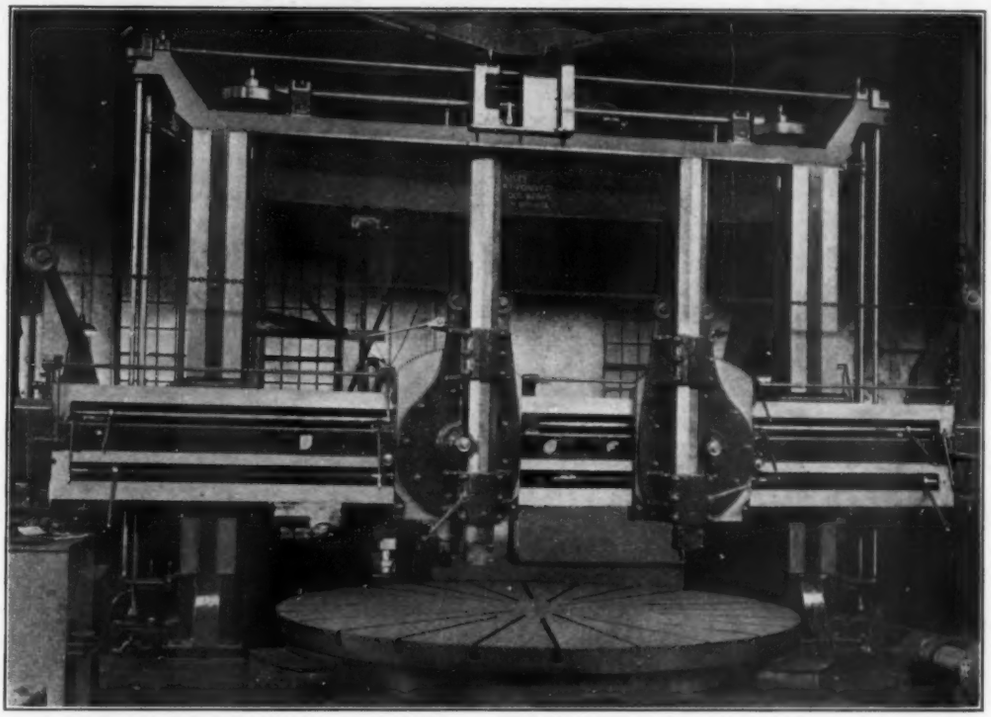

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No. 310 Baker. (3)
No. 422 Baker, Hvy. Pat. (2)
No. 2, two Spindle Colburn.

UPRIGHT DRILLS
21″ Cincinnati Bickford. (9)
24″ Cincinnati Bickford. (10)
28″ Cincinnati Bickford.

SENSITIVE DRILLS
2 spindle Sipp. (2)
No. 2B Edlund, M.D.
2 spindle Edlund. (3)
2 spindle No. 3 Avey. P.F.
2 spindle Allen.
2 spindle Fosdick. P.F.
3 spindle No. 1½ Avey.
3 spdl. Leland Gifford. P.F.
4 spindle Henry Wright. (2)
6 spindle Avey.
8 spindle Allen.

RADIAL DRILLS
3′ American Sensitive Radial.
4′ American Closed head, S.P.D.
4′ Morris Radials. (2)
5′ American Radials. (3)
6′ American. (3)
7′ American.
7′ Dreses.

MULTIPLE SPINDLE DRILLS
No. 12 Natco. No. 14 Natco.

GEAR CUTTERS & HOBBERS
No. 1 Adams Far. Hobber.
No. 12 Barber Colman. (16)
No. 9H G & E Hobber.
11″ Gleason Bevel Finisher.
18 H. G. & E. Hobbers (3)
No. 3, 26″ B & S Automatic.
No. 36-B G & E Automatic Gear Cutter, for Spur & Bevels.
No. 16 H.S. G & E Hob. (9)
No. 36 H G & E Hobbers (3)
96″ G & E Hobber.

CENTERLESS GRINDERS
Heim Motor Drive.
No. 2 Cincinnati, M.D. (2)

DISC GRINDERS
No. 2 Gardner C/S.
No. 10 Besley C/S.
No. 14 Besley C/S.
No. 141 Besley M.D.
18-56″ Besley Vertical M.D.

PLAIN CYLINDRICAL
6″x32″ Norton. (5)
No. 11 B & S. (4)
No. 12 B & S.
10″x18″ Norton BA type.
10″x36″ Norton. (2)
10″x50″ Norton. (2)
12″x18″ Cincinnati. M.D. (3)
12″x48″ Cincinnati.
14″x50″ Norton.
16″x36″ Cincinnati.
16″x72″ Landis.

INTERNAL GRINDERS
No. 70 Heald M.D.
No. 9 Cincinnati.
No. 12 Hydroil Greenfield, Motor Drive.

SURFACE GRINDERS
8″ P & W Vert. Rotary.
No. 3 Wilmarth & Morman.
No. 78 Wilmarth & Morman.
8″ Arter Rotary. (2)
15″x15″x120″ Norton Openside.
No. 10 Blanchard, M.D.
No. 16 Blanchard, 26″ Magnetic chuck. (3)
No. 16A Blanchard Auto. (2)

UNIVERSAL GRINDERS
10″x36″ Thompson.
12″x18″ Cincinnati.
12″x36″ Cincinnati.

MISCELLANEOUS GRINDERS
16″x32″ Landis Crankshaft.
30″ Diamond Heavy Face Grinder.

JIG BORERS
MP4 Sip Swiss. (2)
No. 2 Pratt & Whitney.

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14″x6′ Hendey Cone Drive.
14″x8′ Prentice Grd. Head.
18″x8′ Schumacher Boye & Emmes, Cone Drive.
16″x8′ Hendey Cone D. (3)
16″x8′ Amer. Grd. Hd. (3)
18″x8′ American Grd. Hd.
18″x10′ L & S. Slct. Hd.
19″x8′ LeBlond, Cone Dr.
4″ Lo Swing.
20″x8′ American Geared Head.
20″x12 Schumacher Boye & Emmes.
24″x10 Hendey.

AUTOMATIC MILLER
4—48″ Cincinnati Hydraulic Duplex, M.D.
48″ Cincinnati, Plain Automatic Widemed. (3)

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No. 6 Whitney. (2)
No. 2 Bristol.
No. 2 Pratt & Whitney, M.D.

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No. 2B B & S, M.D. (2)
No. 2 Cincinnati, S. Pull. (3)
No. 2 K & T, special motor in Base. (2)
No. 2B K & T. (2)
No. 3 Cincinnati High Power.
No. 3B K & T. (2)
No. 3B B & S, sgle. pull.
No. 4 LeBlond, Cone Dr.
No. 4B B & S, M.D. (2)
No. 4 Cincinnati, H. Pr., M.D. (2)
No. 5 B & S, M.D.

UNIVERSAL MILLERS
No. 3 Kempsmith, C. Dr.

VERTICAL MILLERS
Model C-2 Becker.
No. 3 Cinci., Mtr. in Base.
No. 4 Cincinnati Feed in Knee.

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36″x36″x12′ Cleveland, openside.
42″x42″x10′ Gray. (2)
48″x48″x10′ Gray.
48″x48″x30′ Cincinnati.
60″x84″x14′ Cleveland, openside.
96″x96″x18′ Niles.

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30 ton Lucas Forcing.

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3¼″x11″ Cincinnati Acme.
No. 6 Gisholt, (5) V belt M.D.
No. 6 Warner & Swaseys, (5)
No. 2A Warn. & Swaseys. (6)
No. 3A Warn. & Swaseys. (4)
24″x26″ Libbeys, one 7⅛″ Hole in Spindle. (2)
No. 2L Gisholt Timken sp.

SHAPERS
No. 16″ Hendey, S.P.D.
No. 20″ Hendy S.P.D.
20″ Smith & Mills, Cone Dr. (2)
25″ Smith & Mills spndl. drive.
20″ G & E, M.D.
24 Gould & Eberhardt, S.P.D.
25″ Smith & Mills, Sgl. Pul.

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16′ Niles-Bement-Pond Boring Mill.
48x48x30′ Cincinnati, double housing, 4 heads
60″x84″x14′ Cleveland, Openside Planer M.D., 3 hds.
96x96x18 Niles, Double Housing Planer, 3 heads.
96″ Gould & Eberhardt Hobber
(2) No. 2 Cincinnati Centerless Grinders.
No. 32 LUCAS BORING MILL

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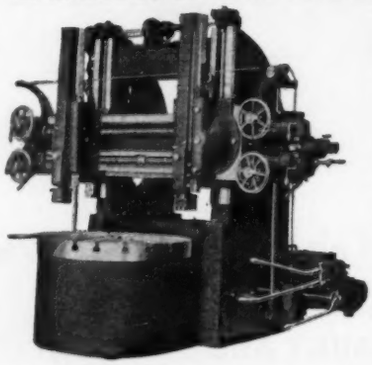

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No. 2 Brown & Sharpe Universal.
No. 20 VanNorman Duplex.
No. 2M Cincinnati Vertical.
No. 2 Kempsmith Vertical Maximill.
No. 14 Garvin Vertical.
No. 4B Brown & Sharpe Plain.
No. 13B Brown & Sharpe Plain
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2¼"x24" Jones & Lamson Steel Flat Head, M.D.

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14"x6' **Monarch Lathe**
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24"x12' **South Bend Lathe**
6x6 **Peerless** High Speed **Hack Saw**
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14x72" Norton, 3 motor drive, late
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No. 3A Universal, 3" bar
No. 1 Cleveland, 2½" bar

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24", 36" Bullard "New Era"
30", 52" King
48", 54", 60" Colburn
62", 72" King

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No. D-4 Colburn Heavy Duty
No. 314, No. 416 Baker
No. 4—5 Spdl. Foote-Burt
No. 14 Natco Multiple
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4' Western, Plain
5' Cincinnati-Bickford Plain
5' American Full Universal
6' Western, Plain

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No. 4—36", No. 4—48" Brown & Sharpe
No. 2, No. 3 Pfauter Hobber
No. 6—60" Brown & Sharpe
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No. 16HS Gould & Eberhardt Hobber

Grinders, 8"x18", 8"x36" Cincinnati, saddle type
20"x168" Landis, plain, M.D.
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No. 4—12"x66" Landis Universal
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6"x32"	10"x50"		14"x72"
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10"x24"	10"—15" GAPx72"		16"x50"
10"—15" GAPx24"	14"x36"		16"x72"
10"x36"	14"x50"		18"x96"
20"x96"		22"x120"	

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26"x10' LeBlond Crankshaft
26"x30' Boye & Emmes, taper attachment
27"x12' American Geared Head
30"x11', 15' American Geared Head
36"x12' L. & S. Sel. Triple Grd. Head
36"x14', 20' L. & S. Sel. Geared Head
66"x21' Putnam, triple geared, Motor Drive

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No. 3 Cincinnati, high power, plain
No. 3-H LeBlond Plain
No. 3-B, No. 4-B Heavy Brown & Sharpe, pl.
No. 3-B Milwaukee Universal
No. 4-A Brown & Sharpe Universal
No. 3-B Milwaukee Vertical
No. 3, No. 4 Cincinnati Vertical
No.5-B, No. 6 Becker Vertical
Hansen-Whitney Thread
6"x14", 6"x48", Pratt & Whitney Thread
No. 4, No. 8 Lees-Bradner Thread
18" & 24" Cincinnati Auto. Duplex
24" Cincinnati Auto. Simplex
No. 33 Kempsmith Production
No. 5—48" Cincinnati Pl. Hydromatic M.D.
24"x24"x12' Ingersoll Adjustable Rail
36"x36"x12' Newton Duplex
38"x44"x20' Ingersoll Slab

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30"x30"x8' American
30"x30"x14' Gray, Rev. Motor Drive
30"x30"x18' Cincinnati
36"x36"x8', 12', 18' Cincinnati
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36"x36"x14'—24' Cleveland Open Side, M.D.
36"x36"x24' Gray
42"x42"x30' Niles Bement Pond, rev. M.D.
48"x48"x18' Det. & Harv., open side
48"x48"x16' Niles-Bement-Pond
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72"x60"x18' American
72"x72"x16' Cincinnati, Motor Drive

Shapers, 20" Smith & Mills
24" Gould & Eberhardt
29" Averbeck

Turret Lathes, No. 1-B Foster Universal
No. 1-A Warner & Swasey, motor drive
No. 3-A Warner & Swasey
No. 4-A Warner & Swasey, Motor Drive
No. 3 Cinn.-Acme, A.C. & B.F.
26" Libby-International, 7½" H.S.

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1—20"x8' **HENDEY LATHE,** Yoke Head, arr. M.D.
1—14"x10' **HENDEY LATHE,** Geared Head, M.D.
1—24" **GOULD & EBERHARDT SHAPER,** Cone Drive.
1—20" **MATTISON SHAPER,** Cone Drive.
3—20" **G & E SHAPERS,** M.D. Thru Gear Box.
1—Model C **BECKER** Vertical **MILL,** S.P.D.
1—Model SD **BECKER** Vertical **MILL,** S.P.D.
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1—No. 3 **CIN. Plain MILL,** M.D. with Motor.
1—No. 2H **BROWN & SHARPE Plain MILL,** C.D.
2—No. 2 **B&S Plain MILLING Machines,** C.D.
1—No. 45 **BILTON Producto-Matic MILL,** M.D.
1—No. 33 **ABRASIVE Sur. GRINDER,** M.D.
1—No. 2 **CINCINNATI Cyl. GRINDER,** B.D.
2—No. 70 **HEALD Internal GRINDERS,** B.D.
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3—21" **CIN. Super DRILL PRESSES,** Direct M.D.
1—1½" Model M **CLEVELAND 4 Spdl. Auto.** M.D.
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1—No. 23-J **BLISS D.C. Gap Frame PRESS,** B.G. M.D.
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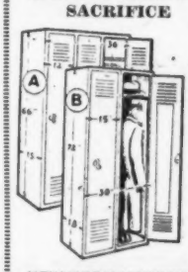

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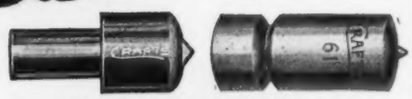

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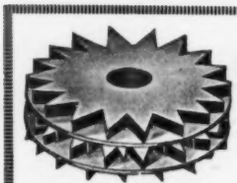

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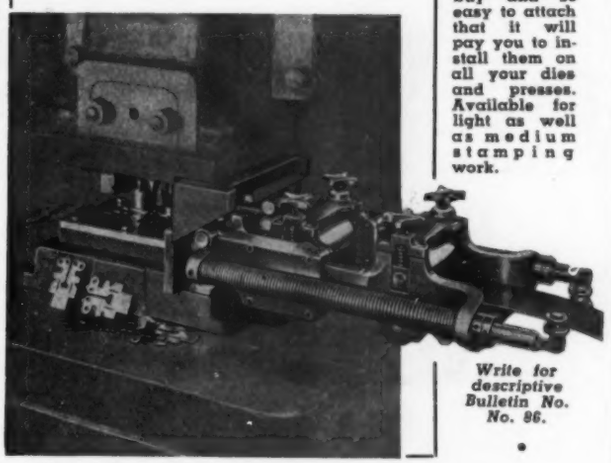

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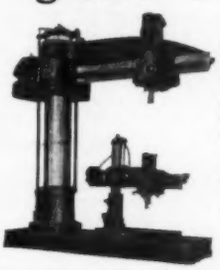

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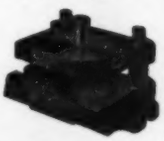

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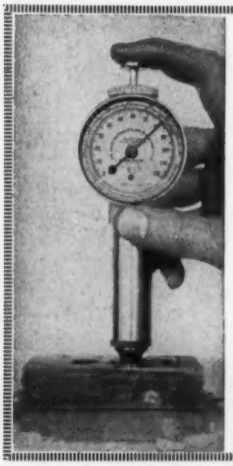

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Brown & Sharpe Mfg. Co., Providence, R. I.
Lufkin Rule Co., Saginaw, Mich
Pratt & Whitney Division Niles-Bement-Pond Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.

GEAR Blanks, Composition
Bakelite Corp., New York, N. Y.

GEAR Burnishing Machine
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, Rochester, N. Y.

GEAR Cutting Machines
Adams Company, Dubuque, Iowa
Barber-Colman Co., Rockford, Ill.
Bilgram Gear & Mach. Works, Phila., Pa.
Brown & Sharpe Mfg. Co., Providence, R. I.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, Rochester, N. Y.
Lees-Bradner Co., Cleveland, Ohio
National Broach & Machine Co., Detroit, Mich.
Scherr Co., Geo., New York, N. Y.
field, Vt.
Waltham Mach. Works, Waltham, Mass.

GEAR Lapping Machines
Fellows Gear Shaper Co., Springfield, Vt.
National Broach & Machine Co., Detroit, Mich.

GEAR Measuring Machines
Fellows Gear Shaper Co., Springfield, Vt.
National Broach & Machine Co., Detroit, Mich.

GEAR Shaving Machines
National Broach & Machine Co., Detroit, Mich.

GEAR Tempering Machines
Gleason Works, Rochester, N. Y.

GEAR Testing Machines
Brown & Sharpe Mfg. Co., Providence, R. I.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, Rochester, N. Y.
Lees-Bradner Co., Cleveland, Ohio
National Broach & Machine Co., Detroit, Mich.

GEARS, Cast
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Grant Gear Works, Boston, Mass.
National-Erie Corp., Erie, Pa.
Perkins Mach. Gear Co., Springfield, Mass.
Philadelphia Gear Works, Philadelphia, Pa.

WHERE-TO-BUY DIRECTORY

GEARS, Cut
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Atlantic Gear Works, New York, N. Y.
Bilgram Gear & Mach. Works, Phila.
Brown & Sharpe Mfg. Co., Providence, R. I.
Earle Gear & Machine Co., Phila., Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Ganschow Gear Co., Chicago, Ill.
Gear Specialties, Inc., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Grant Gear Works, Boston, Mass.
Hartford Special Mchy. Co., Hartford, Conn.
James Co., D. O., Chicago, Ill.
Johnson Mach. Co., Carlyle, Manchester, Conn.
Lempco Products Co., Inc., Bedford, Ohio
Massachusetts Gear & Tool Co., Woburn, Mass.
Meisel Press Mfg. Co., Boston, Mass.
National-Erie Corp., Erie, Pa.
Perkins Mach. & Gear Co., Springfield, Mass.
Philadelphia Gear Works, Philadelphia, Pa.

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General Electric Co., Schenectady, N. Y.
James Co., D. O., Chicago, Ill.
Massachusetts Gear & Tool Co., Woburn, Mass.
Perkins Mach. & Gear Co., Springfield, Mass.

GOGGLES, Safety
American Optical Co., Southbridge, Mass.

GREASE
Texas Co., New York, N. Y.
Tide Water Oil Sales Corp., New York, N. Y.

GRINDERS, Carbide Tool
Ex-Cell-O Corp., Detroit, Mich.

GRINDERS, Heavy Duty
Bryant Machinery and Engineering Co., Chicago, Ill.

GRINDERS, Precision Thread
Jones & Lamson Mach. Co., Springfield, Vt.

GRINDING Machines, Abrasive Belt
Mattison Machine Works, Rockford, Ill.

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Cincinnati Grinders, Incorporated, Cincinnati
Norton Co., Worcester, Mass.

GRINDING Machines Bench
Lee & Son, K. O. Co., Aberdeen, S. D.
Schauer Machine Co., Cincinnati, Ohio
Walker Co., O. S. Worchester, Mass.

GRINDING Machines, Centerless
Cincinnati Grinders, Incorporated, Cincinnati, Ohio.

GRINDING Machines, Chaser
Landis Mach. Co., Waynesboro, Pa.

GRINDING Machines, Chucking
Bryant Chucking Grinder Co., Springfield, Vt.
Heald Machine Co., Worcester, Mass.
Landis Tool Co., Waynesboro, Pa.

GRINDING Machines, Cutter and Tool
Barber-Colman Co., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bryant Chucking Grinder Co., Springfield, Vt.
Cincinnati Milling Mach. Co., The, Cincinnati, Ohio.
Gallmeyer & Livingston Co., Grand Rapids, Mich.
Geometric Tool Co., New Haven, Conn.
Heald Mach. Co., Worcester, Mass.
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Landis Tool Co., Waynesboro, Pa.
LeBlond Machine Tool Co., R. K., Cincinnati, Ohio
Norton Co., Worcester, Mass.
Oliver Instrument Co., Adrian, Mich.
Pratt & Whitney Division Niles-Bement-Pond Co., Hartford, Conn.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Union Twist Drill Co., Athol, Mass.
Walker Co., O. S., Worcester, Mass.

GRINDING Machines, Cylinder
Bryant Chucking Grinder Co., Springfield, Vt.
Heald Mach. Co., Worcester, Mass.
Landis Tool Co., Waynesboro, Pa.

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Arter Grinding Machine Co., Worcester, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Grinders, Incorporated, Cincinnati, Ohio.
Heald Mach. Co., Worcester, Mass.
Landis Tool Co., Waynesboro, Pa.
Norton Co., Worcester, Mass.

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Arter Grinding Machine Co., Worcester, Mass.
Bryant Chucking Grinder Co., Springfield, Vt.
Gallmeyer & Livingston Co., Grand Rapids, Mich.
Heald Machine Co., Worcester, Mass.
Landis Mach. Co., Waynesboro, Pa.
Murchey Machine & Tool Co., Detroit, Mich.
Pratt & Whitney Division Niles-Bement-Pond Co., Hartford, Conn.
Rivett Lathe & Grinder, Inc., Boston, Mass.
Walker Co., O. S., Worcester, Mass.

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Gardner Machine Co., Beloit, Wis.

GRINDING Machines, Drill
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Oliver Inst. Co., Adrian, Mich.
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GRINDING Machines, Gage
Abrasive Mach. Tool Co., East Providence, R. I.
Landis Tool Co., Waynesboro, Pa.

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GRINDING Machines, Hole & Face
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Norton Co., Worcester, Mass.

GRINDING Machines, Internal
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Heald Mach. Co., Worcester, Mass.
Landis Tool Co., Waynesboro, Pa.
Rivett Lathe & Grinder, Inc., Boston, Mass.
Thompson Grinder Co., Springfield, Ohio
Walker Co., O. S., Worcester, Mass.

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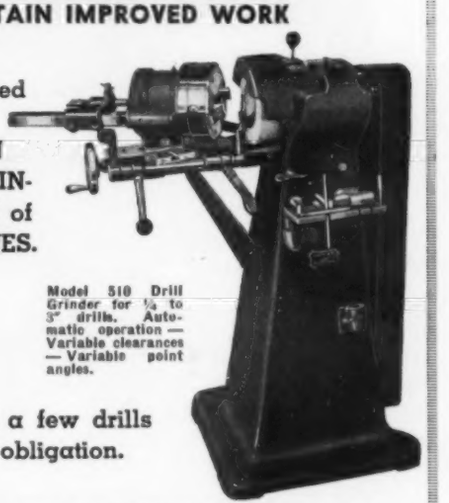

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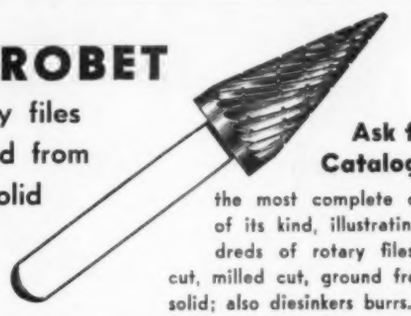

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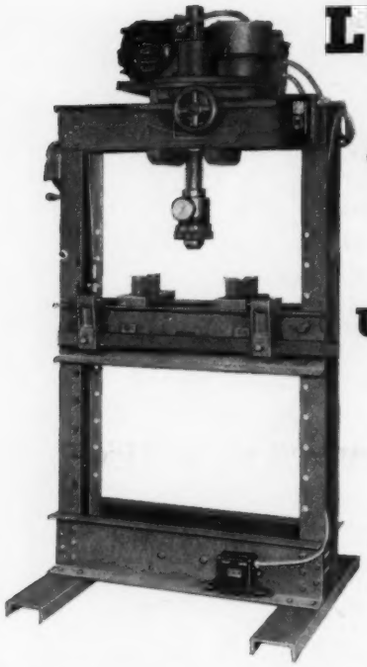

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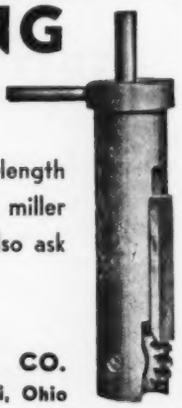

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Norton Co., Worcester, Mass
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Sellers & Co., Inc., Wm., Philadelphia, Pa.

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Greene, Tweed & Co., New York N. Y.

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HANGERS, Shaft
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Shore Inst. & Mfg. Co., Jamaica, L. I., N. Y.
Wilson Mechanical Instrument Co., New York, N. Y.

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Brown & Sharpe Mfg. Co., Providence, R. I.
Scherr Co., Geo., New York, N. Y.

HOBS
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Brown & Sharpe Mfg. Co., Providence, R. I.
Hanson-Whitney Machine Co., Hartford, Conn.
National Twist Drill & Tool Co., Detroit, Mich.
Pratt & Whitney Division Niles-Bement-Pond Co., Hartford, Conn.
Union Twist Drill Co., Athol, Mass.

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Independent Pneumatic Tool Co., Chicago, Ill.
Philadelphia Gear Works, Philadelphia, Pa.

HOISTS & Cranes, Pneumatic
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Independent Pneumatic Tool Co., Chicago, Ill.

HOISTS
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HOISTS, Electric
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HOISTS, Hand
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Micromatic Hone Corp., Detroit, Mich.

HYDRAULIC Power Units
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Federal Products Corp., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

INDICATORS, Speed and Test
Brown & Sharpe Mfg. Co., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

INSTRUMENTS, Electric
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INSTRUMENTS, Light Wave
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JIGS & Fixtures
Hamilton Tool Co., Hamilton, Ohio

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Mitts & Merrill, Saginaw, Mich.
National Mach. Tool Co., Cincinnati, Ohio.

KNURLS & Knurl Holders
American Swiss File & Tool Co., Elizabeth, N. J.
Williams and Co., J. H., Buffalo, N. Y.

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General Electric Vapor Lamp Co., Hoboken, N. J.
Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

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LAPPING Machines, Centerless
Cincinnati Grinders, Incorporated, Cincinnati, Ohio.

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Warner & Swasey Co., Cleveland, Ohio.

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Cleveland Twist Drill Co., Cleveland, Ohio.
Gisholt Machine Co., Madison, Wis.
National Broach & Machine Co., Detroit, Mich.
Ready Tool Co., Bridgeport, Conn.

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Lodge & Shipley Mach. Tool Co., Cincinnati, Ohio.
Potter & Johnston Mach. Co., Pawtuckett, R. I.
Rockford Machine Tool Co., Rockford, Ill.
Warner & Swasey Co., Cleveland, Ohio.

LATHES, Bench
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LeBlond Machine Tool Co., R. K., Cincinnati, Ohio
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Gisholt Machine Co., Madison, Wis.
Warner & Swasey Co., Cleveland, Ohio.

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Boye & Emmes Machine Tool Co., Cincinnati, Ohio
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Modern Tool Works, Rochester, N. Y.
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LATHES, Speed
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Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

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Kearney & Trecker Corp., Milwaukee, Wis.
Potter Johnston Mach. Co., Pawtuckett, R. I.

MILLING Machines, Automatic
Cincinnati Milling Mach. Co., The, Cincinnati, Ohio.
Kearney & Trecker Corp., Milwaukee, Wis.

MILLING Machines, Bench
Pratt & Whitney Division Niles-Bement-Pond Co., Hartford, Conn.
Stark Tool Co., Waltham, Mass.

MILLING Machines, Continuous
Consolidated Mach. Tool Corp., Rochester, N. Y.
Kearney & Trecker Corp., Milwaukee, Wis.
Modern Tool Works, Rochester, N. Y.
Potter & Johnston Mach. Co., Pawtucket, R. I.

MILLING Machines, Drum Type
Consolidated Mach. Tool Corp., Rochester, N. Y.
Modern Tool Works, Rochester, N. Y.

MILLING Machines, Duplex
Cincinnati Milling Mach. Co., The, Cincinnati, Ohio.
Kearney & Trecker Corp., Milwaukee, Wis.
Van Norman Machine Tool Co., Springfield, Mass.

MILLING Machines, Floor Type
Sellers & Co., Inc., Wm., Philadelphia, Pa.

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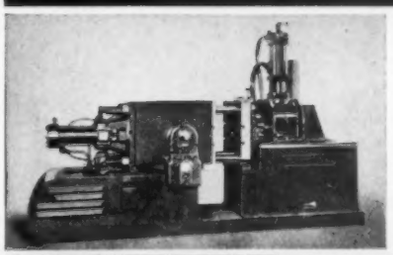

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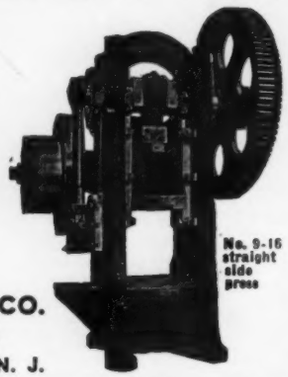

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THE SMITH & MILLS CO. Cincinnati, Ohio

WHERE-TO-BUY DIRECTORY

MILLING Machines, Plain
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., The, Cincinnati, Ohio.
Kearney & Trecker Corp., Milwaukee, Wis.
Nichols, W. H., Waltham, Mass.
Potter & Johnston Machine Co., Pawtucket, R. I.
Sidney Machine Tool Co., Sidney, Ohio

MILLING Machines, Planer Type
Cincinnati Planer Co., Cincinnati, Ohio.
Consolidated Mach. Tool Corp., Rochester, N. Y.
Kearney & Trecker Corp., Milwaukee, Wis.
Modern Tool Works, Rochester, N. Y.
Niles Tool Works Co., Hamilton, Ohio.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

MILLING Machines, Planetary
Consolidated Mach. Tool Corp., Rochester, N. Y.
Modern Tool Works, Rochester, N. Y.

MILLING Machines, Precision Bench
Harding Brothers, Inc., Elmira, N. Y.
Pratt & Whitney Division Niles-Bement-Pond Co., Hartford, Conn.

MILLING Machines, Profile
Consolidated Mach. Tool Corp., Rochester, N. Y.
Modern Tool Works, Rochester, N. Y.
Reed-Prentice Corp., Worcester, Mass.

MILLING Machines, Semi Automatic
Brown & Sharpe Mfg. Co., Providence, R. I.

MILLING Machines, Thread
Adams Company, Dubuque, Iowa
Hanson-Whitney Machine Co., Hartford, Conn.
Lees-Bradner Co., Cleveland, Ohio
Pratt & Whitney Division Niles-Bement-Pond Co., Hartford, Conn.

MILLING Machines, Turret
Bridgeport Machines, Inc., Bridgeport, Conn.

MILLING Machines, Universal
Bridgeport Machines, Inc., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., The, Cincinnati
Kearney & Trecker Corp., Milwaukee, Wis.
Potter & Johnston Machine Co., Pawtucket, R. I.
Preis Engraving Machine Co., N. P., Newark, N. J.
Sidney Machine Tool Co., Sidney, Ohio
Van Norman Machine Tool Co., Springfield, Mass.

MILLING Machines, Vertical
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., The, Cincinnati, Ohio.
Consolidated Mach. Tool Corp., Rochester, N. Y.
Kearney & Trecker Corp., Milwaukee, Wis.
Modern Tool Works, Rochester, N. Y.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Sidney Machine Tool Co., Sidney, Ohio
Van Norman Machine Tool Co., Springfield, Mass.

MILLING Machines, Worm
Pratt & Whitney Division Niles-Bement-Pond Co., Hartford, Conn.

MOTOR-Generators
General Electric Co., Schenectady, N. Y.

MOTORS, Electric
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

MOTORS, Fractional H. P.
General Electric Co., Schenectady, N. Y.

MOTORS, Integral-H. P.
General Electric Co., Schenectady, N. Y.

NUMBERING Machines
Noble & Westbrook Mfg. Co., Hartford, Conn.

NUT Setting Equipment
Independent Pneumatic Tool Co., Chicago, Ill.

OIL & Grease Cups
Gits Bros. Mfg. Co., Chicago, Ill.

OIL Extractors, Centrifugal
De Laval Separator Co., New York,

OIL Grooving Machines
National Mach. Tool Co., Cincinnati, Ohio.

OIL Stones
Norton Co., Worcester, Mass.

OILS, Fuel
Texas Co., New York, N. Y.

OILS, Lubricating
Texas Co., New York, N. Y.

PARALLELS
Brown & Sharpe Mfg. Co., Providence, R. I.
Starrett Co., L. S., Athol, Mass.
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Walker Co., O. S., Worcester, Mass.

PIPE Cutting and Threading Machines
Landis Mach. Co., Waynesboro, Pa.
Murchey Machine & Tool Co., Detroit, Mich.

PIPE Fitters Tools
Greenfield Tap & Die Corp., Greenfield, Mass.
Williams and Co., J. H., Buffalo, N. Y.

PIPE Plugs
Allen Manufacturing Co., Hartford, Conn.

PLANING Machines
Cincinnati Planer Co., Cincinnati, Ohio.
Consolidated Mach. Tool Corp., Rochester, N. Y.
Modern Tool Works, Rochester, N. Y.
Niles Tool Works Co., Hamilton, O.
Ohio Machine Tool Co., Kenton, O.
Rockford Machine Tool Co., Rockford, Ill.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

PLATES, Aluminum
Aluminum Company of America, Pittsburgh, Pa.

PLATES, Steel
American Steel & Wire Co., Chicago, Ill.
Carnegie Illinois Steel (U. S. Steel Corp. Subsidiary), Pittsburgh, Pa.
Columbia Steel Co., (U. S. Steel Corp. Subsidiary), San Francisco, Calif.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Scully Steel Products Co. (U. S. Steel Corp. Subsidiary) New York, N. Y.
U. S. Steel Corp., Pittsburgh, Pa.

POLISHING and Buffing Machines
Haskins Co., R. G., Chicago, Ill.
Heald Mach. Co., Worcester, Mass.
Independent Pneumatic Tool Co., Chicago, Ill.
Landis Tool Co., Waynesboro, Pa.
Mattison Machine Works, Rockford, Ill.
New Britain-Gridley Machine Co., New Britain, Conn.
Pratt & Whitney Division Niles-Bement-Pond Co., Hartford, Conn.
Standard Electrical Tool Co., Cincinnati, Ohio
Union Twist Drill Co., Athol, Mass.

POLISHING Grains, Abrasive
Norton Co., Worcester, Mass.
Carborundum Company, Niagara Falls, N. Y.

PRESS Feeds
Dickerman Mfg. Co., H. E., Springfield, Mass.
V & O Press Co., Hudson, N. Y.

PRESSES, Foot and Hand
Ferracute Machine Co., Bridgeton, N. J.

PRESSES, Forcing
Lucas Mach. Tool Co., Cleveland, Ohio.

PRESSES, Hydraulic
National-Erie Corp., Erie, Pa.

PRESSES, Power
Ferracute Machine Co., Bridgeton, N. J.
Henry & Wright Mfg. Co., Hartford, Conn.
V & O Press Co., Hudson, N. Y.
Zeh & Hahnemann Co., Newark, N. J.

PROFILING Machines
Reed-Prentice Corp., Worcester, Mass.

WHERE-TO-BUY DIRECTORY

PROTRACTORS
Bausch & Lomb Optical Co., Rochester, N. Y.
Brown & Sharpe Mfg. Co., Providence, R. I.
Lufkin Rule Co., Saginaw, Mich.

PULLEYS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Johnson Mach. Co., Carlyle, Manchester, Conn.

PUMPS, Centrifugal
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Brown & Sharpe Mfg. Co., Providence, R. I.

PUMPS, Lubricants
Brown & Sharpe Mfg. Co., Providence, R. I.
Ruthman Machinery Co., Cincinnati, Ohio.

PUMPS, Oil
Brown & Sharpe Mfg. Co., Providence, R. I.
Fulflo Specialties Co., Inc., Blanchester, O.
Ruthman Machinery Co., Cincinnati, Ohio.

PUNCHES, Center and Hand
Lufkin Rule Co., Saginaw, Mich.

PUNCHES, Power
Buffalo Forge Company, Buffalo, N. Y.
Ferracute Machine Co., Bridgeton, N. J.
Mitts & Merrill, Saginaw, Mich.
Wiedemann Mach. Co., Phila., Pa.

PUNCHING and Shearing Machines
Buffalo Forge Company, Buffalo, N. Y.
Consolidated Mach. Tool Corp., Rochester, N. Y.
Modern Tool Works, Rochester, N. Y.

PYROMETERS, Electric
Hoskins Mfg. Co., Detroit, Mich.

REAMERS, Adjustable
Barber-Colman Co., Rockford, Ill.
Cleveland Twist Drill Co., Cleveland, Ohio.
Gisholt Machine Co., Madison, Wis.
Greenfield Tap & Die Corp., Greenfield, Mass.
National Twist Drill & Tool Co., Detroit, Mich.
Pratt & Whitney Division Niles-Bement-Pond Co., Hartford, Conn.
Taft-Peirce Mfg. Co., Woonsocket, R. I.

REAMERS, Solid
Barber-Colman Co., Rockford, Ill.
Cleveland Twist Drill Co., Cleveland, Ohio.
Gisholt Machine Co., Madison, Wis.
Greenfield Tap & Die Corp., Greenfield, Mass.
Holman Reamer Co., Manchester, Conn.
Pratt & Whitney Division Niles-Bement-Pond Co., Hartford, Conn.
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Union Twist Drill Co., Athol, Mass.

REAMING Machines
Independent Pneumatic Tool Co., Chicago, Ill.
Van Norman Machine Tool Co., Springfield, Mass.

RECTIFIERS, Mercury Arc
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

RECTIFIERS, Power
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

REFRACTORIES
Carboloy Company, Detroit, Mich.
Norton Co., Worcester, Mass.

RHEOSTATS
Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

RIVETING Machines
Buffalo Forge Company, Buffalo, N. Y.
Grant Mfg. & Mach. Co., Bridgeport, Conn.
Independent Pneumatic Tool Co., Chicago, Ill.
Tomkins-Johnson Co., Jackson, Mich.

RIVET Making Machines
Acme Machinery Co., Cleveland, Ohio

RIVET Sets
American Swiss File & Tool Co., Elizabeth, N. J.

RODS, Welding
Lincoln Electric Co., Cleveland, Ohio

ROPE Wire
Lufkin Rule Co., Saginaw, Mich.
Page Steel & Wire Div., American Chain & Cable Co., Inc., Monessen, Pa.
Roebling's Sons Co., John A., Trenton, N. J.

RULES, Steel
Starrett Co., L. S., Athol, Mass.

RULES, Steel & Wood
Brown & Sharpe Mfg. Co., Providence, R. I.

SANDERS
Mattison Machine Works, Rockford, Ill.

SAWING Machines, Band
Armstrong-Blum Mfg. Co., Chicago, Ill.
Cleereman Machine Tool Co., Chicago, Ill.

SAWING Machines, Power Hack
Armstrong-Blum Mfg. Co., Chicago, Ill.
Avey Drilling Machine Co., Cincinnati, Ohio.
Earle Gear & Mach. Co., Phila., Pa.

SAWS, Hack
Armstrong-Blum Mfg. Co., Chicago, Ill.
Starrett Co., L. S., Athol, Mass.

SAWS, Hack, Frames and Blades
Delta Mfg. Co., Milwaukee, Wis.
Starrett Co., L. S., Athol, Mass.

SAWS, Metal Cutting
Avey Drilling Machine Co., Cincinnati, Ohio.

SAWS, Milling
Barber-Colman Co., Rockford, Ill.
Pratt & Whitney Division Niles-Bement-Pond Co., Hartford, Conn.
Union Twist Drill Co., Athol, Mass.

SAWS, Screw Slotting
Pratt & Whitney Division Niles-Bement-Pond Co., Hartford, Conn.
Union Twist Drill Co., Athol, Mass.

SCREW Driving Machines
Haskins Co., R. G., Chicago, Ill.

SCREW Extractors
Cleveland Twist Drill Co., Cleveland, Ohio.

SCREW Machine Products
Aluminum Company of America, Pittsburgh, Pa.

SCREW Machine Tools and Attachments
Brown & Sharpe Mfg. Co., Providence, R. I.
Pratt & Whitney Division Niles-Bement-Pond Co., Hartford, Conn.

SCREW Machine Work
Eastern Mach. Screw Corp., New Haven, Conn.
National Mach. Tool Co., Cincinnati, Ohio.
New Britain-Gridley Machine Co., New Britain, Conn.
Taft-Peirce Mfg. Co., Woonsocket, R. I.

SCREW Machines
Acme Machine Tool Co., Cincinnati, Ohio
Brown & Sharpe Mfg. Co., Providence, R. I.
Warner & Swasey Co., Cleveland, Ohio.

SCREW Machines, Automatic and Semi Automatic
Brown & Sharpe Mfg. Co., Providence, R. I.
Cone Automatic Machine Co. Windsor, Vt.
National Acme Co., Cleveland, Ohio.
New Britain-Gridley Machine Co., New Britain, Conn.
Warner & Swasey Co., Cleveland, Ohio.

SCREW Machines, Plain or Hand
Gisholt Machine Co., Madison, Wis.
Jones & Lamson Mach. Co., Springfield, Vt.

SCREW Plates
Greenfield Tap & Die Corp., Greenfield, Mass.

SCREW Threading Machines
Brown & Sharpe Mfg. Co., Providence, R. I.

SCREWS, Cap and Set
Allen Mfg. Co., Hartford, Conn.
Danly Mach. Spec. Co., Inc., Chicago, Ill.

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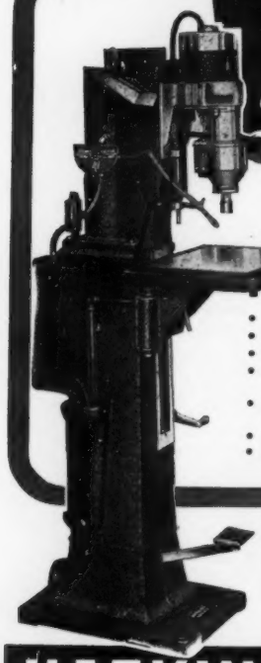

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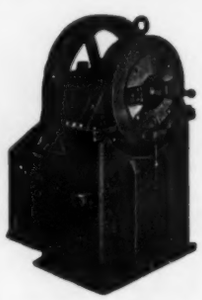

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56 Field Street Torrington, Conn.

WHERE-TO-BUY DIRECTORY

Eastern Mach. Screw Corp., New Haven, Conn.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Strong Carlisle & Hammond Co., Cleveland, Ohio

SCREWS, Machine
Allen Mfg. Co., Hartford, Conn.
Eastern Mach. Screw Corp., New Haven, Conn.

SCREWS, Recessed Head
American Screw Co., Providence, R. I.
Chandler Products Co., Cleveland, Ohio
Continental Screw Co., New Bedford, Mass.
Corbin Screw Corp., New Britain, Conn.
Lamson & Sessions Co., Cleveland, Ohio.
National Screw & Mfg. Co., Cleveland, Ohio.
Parker-Kalon Corp., New York, N. Y.
Pheoll Mfg. Co., Chicago, Ill.
Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
Scovill Mfg. Co., Waterbury, Conn.

SCREWS, Safety
Standard Pressed Steel Co., Jenkintown, Pa.
Strong , Carlisle & Hammond Co., Cleveland, Ohio

SCREWS, Shoulder
Allen Mfg. Co., Hartford, Conn.

SEPARATORS, Oil & Waste
De Laval Separator Co., New York,

SHAFTING
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Scully Steel Products Co. (U. S. Steel Corp. Subsidiary) New York, N. Y.
Wyckoff Drawn Steel Co., Pittsburgh, Pa.

SHAFTS, Flexible
Haskins Co., R. G., Chicago, Ill.

SHAPERS
American Tool Works Co., Cincinnati, Ohio.
Bryant Machinery and Engineering Co., Chicago, Ill.
Hanson-Whitney Machine Co., Hartford, Conn.
Hendey Machine Co., Torrington, Conn.
Ohio Machine Tool Co., Kenton, O.
Pratt & Whitney Division Niles-Bement-Pond Co., Hartford, Conn.
Rockford Machine Tool Co., Rockford, Ill.
Smith & Mills Co., Cincinnati, Ohio.

SHAPES, Structural Steel
American Steel & Wire Co., Chicago, Ill.
Carnegie Illinois Steel (U. S. Steel Corp. Subsidiary), Pittsburgh, Pa.
Columbia Steel Co., (U. S. Steel Corp. Subsidiary), San Francisco, Calif.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Scully Steel Products Co. (U. S. Steel Corp. Subsidiary) New York, N. Y.
U. S. Steel Corp., Pittsburgh, Pa.

SHARPENING Stones
Carborundum Company, Niagara Niagara Falls, N. Y.
Norton Co., Worcester, Mass.

SHEARS, Power
Buffalo Forge Company, Buffalo, N. Y.
Consolidated Mach. Tool Corp., Rochester, N. Y.
Mitts & Merrill, Saginaw, Mich.
Modern Tool Works, Rochester, N. Y

SHEAVES, V Belt
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
National-Erie Corp., Erie, Pa.

SHIELDS, Welding
Lincoln Electric Co., Cleveland, Ohio

SLOTTING Machines
Consolidated Machine Tool Corp., Rochester, N. Y.
Modern Tool Works, Rochester, N. Y.

SOCKETS
Cleveland Twist Drill Co., Cleveland, Ohio.
Union Twist Drill Co., Athol, Mass.

SOCKETS, Detachable Head
Armstrong Bros. Tool Co., Chicago, Ill.

SOCKETS, Wire Rope
Williams and Co., J. H., Buffalo, N. Y.

SPECIAL Machines
Ex-Cell-O Corp., Detroit, Mich.

SPEED Reducers
Adams Company, Dubuque, Iowa
Cullman Wheel Co., Chicago, Ill.
Earle Gear & Mach. Co., Chicago, Ill.
Grant Gear Works, Boston, Mass.
James Co., D. O., Chicago, Ill.
Philadelphia Gear Works, Philadelphia, Pa.
Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

SPEED Reducers, Motorized
James Co., D. O., Chicago, Ill.
Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

SPINDLES, Grinding
Ex-Cell-O Corp., Detroit, Mich.

SPOT Welder Control
General Electric Co., Schenectady, N. Y.

SPROCKETS
Bilgrim Gear & Mach. Works, Phila., Pa.
Cullman Wheel Co., Chicago, Ill.
Grant Gear Works, Boston, Mass.
James Co., D. O., Chicago, Ill.
National-Erie Corp., Erie, Pa.
Philadelphia Gear Works, Philadelphia, Pa.

SQUARES
Brown & Sharpe Mfg. Co., Providence, R. I.
Lufkin Rule Co., Saginaw, Mich.
Starrett Co., L. S., Athol, Mass.

STAMPS, Steel
Noble & Westbrook Mfg. Co., Hartford, Conn.

STARTERS, Motor
Lincoln Electric Co., Cleveland, Ohio

STAYBOLTS
Carnegie Illinois Steel (U. S. Steel Corp. Subsidiary), Pittsburgh, Pa.

STEEL Alloy, Carbon
Latrobe Elec. Steel Co., Latrobe, Pa.
Wyckoff Drawn Steel Co., Pittsburgh, Pa.

STEEL, Cold Finished
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Scully Steel Products Co. (U. S. Steel Corp. Subsidiary) New York, N. Y.
Wyckoff Drawn Steel Co., Pittsburgh, Pa.

STEEL, High Speed
Armstrong Bros. Tool Co., Chicago, Ill.
Crucible Steel Co., New York, N. Y.
Latrobe Elec. Steel Co., Latrobe, Pa
Williams and Co., J. H., Buffalo, N. Y.

STEEL, Pipe
National Tube Co., (U. S. Steel Corp. Subsidiary) Pittsburgh, Pa.

STEEL, Screw
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Scully Steel Products Co. (U. S. Steel Corp. Subsidiary) New York, N. Y.
Wyckoff Drawn Steel Co., Pittsburgh, Pa.

STEEL, Rustless & Stainless
Crucible Steel Co., New York, N. Y.

STEEL, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Crucible Steel Co., New York, N. Y.

STEELS, Alloy, Carbon and High Speed
American Steel & Wire Co., Chicago, Ill.
Carnegie Illinois Steel (U. S. Steel Corp. Subsidiary), Pittsburgh, Pa.
Columbia Steel Co., (U. S. Steel Corp. Subsidiary), San Francisco, Calif.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Scully Steel Products Co. (U. S. Steel Corp. Subsidiary) New York, N. Y.
U. S. Steel Corp, Pittsburgh, Pa.
Wyckoff Drawn Steel Co., Pittsburgh, Pa.

WHERE-TO-BUY DIRECTORY

STRAIGHT Edges
Brown & Sharpe Mfg. Co., Providence, R. I.

STRAIGHTENING Machinery
Springfield Mach. Tool Co., Springfield, O.

STRUCTURAL Shapes
Aluminum Company of America, Pittsburgh, Pa.

SUB Presses and Dies
Danly Mach. Spec. Co., Inc., Chicago, Ill.

SURFACE Plates
Brown & Sharpe Mfg. Co., Providence, R. I.

SWAGING Machines
Etna Machine Co., Toledo, Ohio.
Torrington Co., Torrington, Conn.

TANKS, Aluminum
Aluminum Company of America, Pittsburgh, Pa.

TAP Extensions
Allen Mfg. Co., Hartford, Conn.

TAPER Pins
Pratt & Whitney Division Niles-Bement-Pond Co., Hartford, Conn.

TAPES Measuring
Lufkin Rule Co., Saginaw, Mich.
Starrett Co., L. S., Athol, Mass.

TAPPING Machines and Attachments
Avey Drilling Machine Co., Cincinnati, Ohio.
Barber-Colman Co., Rockford, Ill.
Buffalo Forge Company, Buffalo, N. Y.
Cincinnati Bickford Tool Co., Cincinnati, O.
Haskins Co., R. G., Chicago, Ill.

TAPPING Machines, Nut
Acme Machinery Co., Cleveland, Ohio

TAPPING Machines, Pipe Coupling
Acme Machinery Co., Cleveland, Ohio

TAPS and Dies
Geometric Tool Co., New Haven, Conn.
Greenfield Tap & Die Corp., Greenfield, Mass.
Hanson-Whitney Machine Co., Hartford, Conn.
Landis Machine Co., Waynesboro, Pa.
Pratt & Whitney Division Niles-Bement-Pond Co., Hartford, Conn.
Winter Bros. Co., Inc., Wrentham, Mass.

TAPS, Collapsing
Landis Machine Co., Waynesboro, Pa.
Modern Tool Works, Div. of Consolidated Mach. Tool Corp. of America, Rochester, N. Y.
National Acme Co., Cleveland, Ohio.

TAPS, Ground
Greenfield Tap & Die Corp., Greenfield, Mass.
Hanson-Whitney Machine Co., Hartford, Conn.
Winter Bros. Co., Inc., Wrentham, Mass.

TESTING Apparatus, Hardness
Shore Instrument & Mfg. Co., Jamaica, L. I., N. Y.
Wilson Mechanical Instrument Co., New York, N. Y.

THREAD-CUTTING Machines
Acme Machinery Co., Cleveland, Ohio
Eastern Mach. Screw Corp., New Haven, Conn.
Ex-Cell-O Corp., Detroit, Mich.
Geometric Tool Co., New Haven, Conn.
Grant Mfg. & Machine Co., Bridgeport, Conn.
Greenfield Tap & Die Corp., Greenfield, Mass.
Landis Machine Co., Waynesboro, Pa.
Rivett Lathe & Grinder, Inc., Boston, Mass.
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Waltham Mach. Works, Waltham, Mass.
Warner & Swasey Co., Cleveland Ohio.

THREAD Cutting Tools
Acme Machinery Co., Cleveland, Ohio
Eastern Mach. Screw Corp., New Haven, Conn.
Geometric Tool Co., New Haven, Conn.
Greenfield Tap & Die Corp., Greenfield, Mass.
Hanson-Whitney Machine Co., Hartford, Conn.
Jones & Lamson Mach. Co., Springfield, Vt.
Landis Mach. Co., Waynesboro, Pa.
Rivett Lathe & Grinder, Inc., Boston, Mass.
Taft-Peirce Mfg. Co., Woonsocket, R. I.

THREADERS, Pipe
Armstrong Bros. Tool Co., Chicago, Ill.
Warner & Swasey Co., Cleveland, Ohio.

TIMERS, Production
National Acme Co., Cleveland, Ohio.

TONGS, Lifting
Armstrong Bros. Tool Co., Chicago, Ill.

TOOL Bits
Carboloy Company, Detroit, Mich.
Cleveland Twist Drill Co., Cleveland, Ohio.
Gisholt Machine Co., Madison, Wis.
Warner & Swasey Co., Cleveland, Ohio.

TOOL Cribs
Frick-Gallagher Mfg. Co., Wellston, Ohio

TOOL Holders
Armstrong Bros. Tool Co., Chicago, Ill.
Gisholt Machine Co., Madison, Wis.
Ready Tool Co., Bridgeport, Conn.
Warner & Swasey Co., Cleveland, Ohio.
Williams and Co., J. H., Buffalo, N. Y.

TOOL Posts, Lathe
Williams and Co., J. H., Buffalo, N. Y.

TOOL Work
Dickerman Mfg. Co., H. E., Springfield, Mass.
Taft-Peirce Mfg. Co., Woonsocket, R. I.

TOOLS, Boring
Armstrong Bros. Tool Co., Chicago, Ill.
Bullard Company, Bridgeport, Conn.
Carboloy Company, Detroit, Mich.
Gisholt Machine Co., Madison, Wis.
Warner & Swasey Co., Cleveland Ohio.

TOOLS, Carbide Alloy
Carboloy Company, Detroit, Mich.
Crafts & Co., Inc., Arthur A., Boston, Mass.
Warner & Swasey Co., Cleveland, Ohio.

TOOLS, Cutting
Carboloy Company, Detroit, Mich.
Warner & Swasey Co., Cleveland, Ohio.

TOOLS, Cutting Off
Armstrong Bros. Tool Co., Chicago, Ill.
Williams and Co., J. H., Buffalo, N. Y.

TOOLS, Diamond
Bausch & Lomb Optical Co., Rochester, N. Y.

TOOLS, Knurling
Armstrong Bros. Tool Co., Chicago, Ill.
Warner & Swasey Co., Cleveland Ohio.

TOOLS, Lathe
Bullard Company, Bridgeport, Conn.
Carboloy Company, Detroit, Mich.
Cleveland Twist Drill Co., Cleveland, Ohio.
Gisholt Machine Co., Madison, Wis.
Warner & Swasey Co., Cleveland, Ohio.
Williams and Co., J. H., Buffalo, N. Y.

TOOLS, Lathe, Shaper & Planer
Armstrong Bros. Tool Co., Chicago, Ill.

TOOLS, Pipe Threading
Armstrong Bros. Tool Co., Chicago, Ill.
Warner & Swasey Co., Cleveland, Ohio.

TOOLS, Portable & Pneumatic
Independent Pneumatic Tool Co., Chicago, Ill.

TOOLS, Roughing & Finishing
G. K. Tool Co., Shelton, Conn.

TOOLS, Shaper & Planer
Williams and Co., J. H., Buffalo, N. Y.

TOOLS, Thread Cutting
Williams and Co., J. H., Buffalo, N. Y.

TOOLS, Tungsten Carbide Tipped
Warner & Swasey Co., Cleveland, Ohio.

TOOLS, Turning
Warner & Swasey Co., Cleveland, Ohio.
Williams and Co., J. H., Buffalo, N. Y.

TOOLS, Turret Lathe and Screw Machine
Armstrong Bros. Tool Co., Chicago, Ill.
Gisholt Machine Co., Madison, Wis.
Warner & Swasey Co., Cleveland, Ohio.

TRANSFORMERS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.
Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

TRANSMISSION Equipment
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

TUBING, Aluminum and Seamless
Aluminum Company of America, Pittsburgh, Pa.

TUNGSTEN, Carbide Tool
Warner & Swasey Co., Cleveland, Ohio.

TURBINES, Steam
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

TURRETS, Tool Post
American Tool Works Co., Cincinnati
Gisholt Machine Co., Madison, Wis.
Warner & Swasey Co., Cleveland, Ohio.

UPSETTING & Forging Machines
Acme Machinery Co., Cleveland, Ohio

USED Machinery (See Searchlight Section)
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Bernstein & Co., Geo. M., Chicago, Ill.
Central Mach. Tool Corp., Toledo, O.
Cincinnati Mchy. & Supply Co., Cincinnati, Ohio.
Eastern Mchy. Co., Cincinnati
Emerman & Co., Louis E., Chicago, Ill.
Falk Machinery Co., Inc., Rochester, N. Y.
Hill Clarke Machinery Co., Chicago
Hyman & Sons, Jos., Phila.
Indianapolis Mchy. & Supply Co., Indianapolis, Ind.
Industrial Mchy. Co., Indianapolis, Ind.
Iroquois Mchy. Co., Buffalo, N. Y
Interstate Machinery Co., Inc., Chicago, Ill.
Inland Machinery Co., Chicago, Ill.
Lucas & Son, J. L., Bridgeport, Conn.
Lunney, Frank J., Phila., Pa.
Marr Galbreath Machinery Co., Pittsburgh, Pa.
McDonald Machy. Co., St. Louis, Mo.
Miles Mchy. Co., Saginaw, W. S., Mich.
Monarch Machy. Co., Phila., Pa.
Morey & Co., Inc., New York, N. Y.
Motch & Merryweather Machy. Co., Cleveland, Ohio
Moyer, J. N., Phila., Pa.
O'Brien Mchy. Co., Philadelphia, Pa.
Osborne & Sexton Mchy. Co., Columbus, Ohio.
Ott Mchy. Sales Co., Detroit, Mich.
Rosencrans & Weisbecker & Co., Inc., N. Y. C.
Simmons Mach. Tool Corp, Albany, N. Y.
Strong, Carlisle & Hammond Co., Cleveland, Ohio; Detroit, Mich.
Sun Machinery Co., Newark, N. J.
Surplus Material & Mchy. Co., Detroit, Mich.
Wachs-Gregg & Co., Chicago, Ill.
West Penn Mchy. Co., Pittsburgh, Pa.

V BELTS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

VERNIERS
Brown & Sharpe Mfg. Co., Providence, R. I
Starrett Co., L. S., Athol, Mass.

VISE Stands
New Britain-Gridley Machine Co., New Britain, Conn.

VISES, Drilling Machines
Armstrong-Blum Mfg. Co., Chicago Ill.
Graham Mfg. Co., Providence, R. I.
Hartford Special Mchy. Co., Hartford, Conn.

VISES, Machinist
Desmond-Stephan Mfg. Co., Urbana, Ohio.
Wiedemann Machine Co., Phila., Pa.

VISES, Milling Machines
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., The, Cincinnati, Ohio.
Hartford Special Mchy. Co., Hartford, Conn.
Kearney & Trecker Corp., Milwaukee, Wis.

VISES, Pipe
Armstrong Bros. Tool Co., Chicago, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
Williams and Co., J. H., Buffalo, N. Y.

WASHERS
H. K. Metalcraft Corp., New York, N. Y.

WELDERS, Electric
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WELDING Electrodes
General Electric Co., Schenectady, N. Y.
Page Steel & Wire Div., American Chain & Cable Co., Inc., Monessen, Pa.

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Lincoln Electric Co., Cleveland, Ohio

WELDING Machines & Equipment Elec. Arc.
Lincoln Electric Co., Cleveland, Ohio

WELDING Machines, Electric
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WELDING Supplies, Electric
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Aluminum Company of America, Pittsburgh, Pa.

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WRENCHES, Drop Forged
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WRENCHES, Socket
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Williams and Co., J. H., Buffalo, N. Y.

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